SUPPLEMENT

TO THE

ENCYCLOPÆDIA BRITANNICA.

SUPPLEMENT

TO THE

FOURTH, FIFTH, AND SIXTH EDITIONS

OF THE

ENCYCLOPÆDIA BRITANNICA.

WITH PRELIMINARY DISSERTATIONS

ON THE

HISTORY OF THE SCIENCES.

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VOLUME FOURTH.

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ADVERTISEMENT

TO

THE FOURTH VOLUME.

It was stated in a former Advertisement, * that the Second Part of Mr Stewart's Dissertation on the History of *Metaphysical, Ethical, and Political Philosophy*, would accompany the present Half-Volume. Circumstances having rendered it necessary to postpone the appearance of that Part, till a later period in the progress of this Work, it was agreed, that the remaining Part of Professor Playfair's Dissertation on the History of the *Mathematical and Physical Sciences* should, in the mean time, take its place. It is to this arrangement, that the World is indebted for a Piece, which, though it only forms part of a greater design, cannot but be regarded as a most valuable contribution to the History of Science; whilst it derives a melancholy interest, from its being the last literary object that employed the talents, and engaged the solicitude, of its eminent author.

Mr Playfair's Dissertation was intended to furnish an historical sketch of the principal discoveries and improvements in Science, from the revival of Letters to the beginning of the present century; and, in that portion of it which is prefixed to the *Second* Volume of this work, the history is brought down to the period marked by the commencement of Newton's discoveries. The remaining half was to have completed the design, in *three* parts or subdivisions; the First, comprehending the period of Newton and Leibnitz;

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* *Advertisement* to Volume Third.

the Second, that of EULER and D'ALEMBERT; and the Third, that of LAGRANGE and LAPLACE.

Mr PLAYFAIR was proceeding, with his accustomed diligence and ardour, in the execution of this interesting and congenial task, when he was seized with the illness of which he died. The *first* subdivision of his plan, which embraces a view of the advances made in the most remarkable period of the history of Science, was happily completed, and the printing finished, while he was yet able to correct the Press. It is now given to the Public, under the painful impression that it must too probably be considered as a *Fragment*; for the Editor fears, that the materials collected for the completion of the Dissertation, though containing the results of much elaborate inquiry, and profound reflection, cannot be put into a shape that would justify their publication as a work of PROFESSOR PLAYFAIR.

Edinburgh, December 1819.

DISSERTATION SECOND:

EXHIBITING A GENERAL VIEW

OF THE

PROGRESS OF MATHEMATICAL AND PHYSICAL SCIENCE,

SINCE THE REVIVAL OF LETTERS IN EUROPE.

PART II.

By JOHN PLAYFAIR,

LATE PROFESSOR OF NATURAL PHILOSOPHY IN THE UNIVERSITY OF EDINBURGH,
FELLOW OF THE ROYAL SOCIETY OF LONDON,
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DISSERTATION SECOND.

SKETCH OF THE PROGRESS OF NATURAL PHILOSOPHY FROM THE REVIVAL OF LEARNING TO THE PRESENT TIME.

PART SECOND.

FROM THE COMMENCEMENT OF NEWTON'S DISCOVERIES TO THE YEAR 1818.

In the former part of this sketch, the history of each division of the sciences was continued without interruption, from the beginning to the end. During the period, however, on which I am now to enter, the advancement of knowledge has been so rapid, and marked by such distinct steps, that several pauses or resting-places occur of which it may be advisable to take advantage. Were the history of any particular science to be continued for the whole of the busy interval which this second part embraces, it would leave the other sciences too far behind; and would make it difficult to perceive the mutual action by which they have so much assisted the progress of one another. Considering some sort of subdivision, therefore, as necessary, and observing, in the interval which extends from the first of Newton's discoveries to the year 1818, three different conditions of the Physico-Mathematical sciences, well marked and distinguished by great improvements, I have divided the above interval into three corresponding parts. The first of these, reaching from the commencement of Newton's discoveries in 1663, to a little beyond his death, or to 1730, may be denominated, from the men who impressed on it its peculiar character, *the period of Newton and Leibnitz.* The second, which, for a similar reason, I call that of *Euler and D'Alembert*, may be regarded as extending from 1730 to 1780; and the third, that of *Lagrange and Laplace*, from 1780 to 1818.

PERIOD FIRST.

SECTION I.

THE NEW GEOMETRY.

THE seventeenth century, which had advanced with such spirit and success in combating prejudice, detecting error, and establishing truth, was destined to conclude with the most splendid series of philosophical discoveries yet recorded in the history of letters. It was about to witness, in succession, the invention of Fluxions, the discovery of the Composition of Light, and of the Principle of Universal Gravitation,—all three within a period of little more than twenty years, and all three the work of the same individual. It is to the first of these that our attention at present is to be particularly directed.

The notion of Infinite Quantity had, as we have already seen, been for some time introduced into Geometry, and having become a subject of reasoning and calculation, had, in many instances, after facilitating the process of both, led to conclusions from which, as if by magic, the idea of infinity had entirely disappeared, and left the geometer or the algebraist in possession of valuable propositions, in which were involved no magnitudes but such as could be readily exhibited. The discovery of such results had increased both the interest and extent of mathematical investigation.

It was in this state of the sciences, that Newton began his mathematical studies, and, after a very short interval, his mathematical discoveries.[1] The book, next to the elements, which was put into his hands, was Wallis's *Arithmetic of Infinites*, a work well fitted for suggesting new views in geometry, and calling into activity the powers of mathematical invention. Wallis had effected the quadrature of all those curves in which the value of one of the co-ordinates can be expressed in terms of the other, without involving either fractional or negative exponents. Beyond this point

[1] He entered at Trinity College, Cambridge, in June 1660. The date of his first discoveries is about 1663.

neither his researches, nor those of any other geometer, had yet reached, and from this point the discoveries of Newton began. The Savilian Professor had himself been extremely desirous to advance into the new region, where, among other great objects, the quadrature of the circle must necessarily be contained, and he made a very noble effort to pass the barrier by which the undiscovered country appeared to be defended. He saw plainly, that if the equations of the curves which he had squared were ranged in a regular series, from the simpler to the more complex, their areas would constitute another corresponding series, the terms of which were all known. He farther remarked, that, in the first of these series, the equation to the circle itself might be introduced, and would occupy the middle place between the first and second terms of the series, or between an equation to a straight line and an equation to the common parabola. He concluded, therefore, that if, in the second series, he could interpolate a term in the middle, between its first and second terms, this term must necessarily be no other than the area of the circle. But when he proceeded to pursue this very refined and philosophical idea, he was not so fortunate; and his attempt toward the requisite interpolation, though it did not entirely fail, and made known a curious property of the area of the circle, did not lead to an indefinite quadrature of that curve.[1] Newton was much more judicious and successful in his attempt. Proceeding on the same general principle with Wallis, as he himself tells us, the simple view which he took of the areas already computed, and of the terms of which each consisted, enabled him to discover the law which was common to them all, and under which the expression for the area of the circle, as well as of innumerable other curves, must needs be comprehended. In the case of the circle, as in all those where a fractional exponent appeared, the area was exhibited in the form of an infinite series.

The problem of the quadrature of the circle, and of so many other curves, being thus resolved, Newton immediately remarked, that the law of these series was, with a small alteration, the law for the series of terms which expresses the root of any binomial quantity whatsoever. Thus he was put in possession of another valuable discovery, the Binomial Theorem, and at the same time perceived that this last was in reality, in the order of things, placed before the other, and afforded a much easier access to such

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[1] The interpolation of Wallis failed, because he did not employ literal or general exponents. His theorem, expressing the area of the entire circle by a fraction, of which the numerator and denominator are each the continued product of a certain series of numbers, is a remarkable anticipation of some of Euler's discoveries, *Calc. Int.* Tom. I. cap. 8.

quadratures than the method of interpolation, which, though the first road, appeared now neither to be the easiest nor the most direct.

It is but rarely that we can lay hold with certainty of the thread by which genius has been guided in its first discoveries. Here we are proceeding on the authority of the author himself, for in a letter to Oldenburgh,[1] Secretary of the Royal Society of London, he has entered into considerable detail on this subject, adding (so ready are the steps of invention to be forgotten), that the facts would have entirely escaped his memory, if he had not been reminded of them by some notes which he had made at the time, and which he had accidentally fallen on. The whole of the letter just referred to is one of the most valuable documents to be found in the history of invention.

In all this, however, nothing occurs from which it can be inferred that the method of fluxions had yet occurred to the inventor. His discovery consisted in the method of reducing the value of y, the ordinate of a curve, into an infinite series of the integer powers of x the abscissa, by division, or the extraction of roots, that is, by the Binomial Theorem ; after which, the part of the area belonging to each term could be assigned by the arithmetic of infinites, or other methods already known. He has assured us himself, however, that the great principle of the new geometry was known to him, and applied to investigation as early as 1665 or 1666.[2] Independently of that authority, we also know, on the testimony of Barrow, that soon after the period just mentioned, there was put into his hands by Newton a manuscript treatise,[3] the same which was afterwards published under the title of *Analysis per Æquationes Numero Terminorum Infinitas*, in which, though the instrument of investigation is nothing else than infinite series, the principle of fluxions, if not fully explained, is at least distinctly pointed out. Barrow strongly exhorted his young friend to publish this treasure to the world ; but the modesty of the author, of which the excess, if not culpable, was certainly in the present instance very unfortunate, prevented his compliance. All this was previous to the year 1669 ; the treatise itself was not published till 1711, more than forty years after it was written.

For a long time, therefore, the discoveries of Newton were only known to his friends, and the first work in which he communicated any thing to the world on the subject of fluxions was in the first edition of the *Principia*, in 1687, in the second *Lemma* of

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[1] *Commercium Epistolicum*, Art. 55.
[2] *Quadrature of Curves*, Introduction
[3] *Com. Epist.* No. I. II. III. &c.

the second book, to which, in the disputes that have since arisen about the invention of the new analysis, reference has been so often made. The principle of the fluxionary calculus was there pointed out, but nothing appeared that indicated the peculiar algorithm, or the new notation, which is so essential to that calculus. About this Newton had yet given no information; and it was only from the second volume of Wallis's Works, in 1693, that it became known to the world.[1] It was no less than ten years after this, in 1704, that Newton himself first published a work on the new calculus, his *Quadrature of Curves*, more than twenty-eight years after it was written.

These discoveries, however, even before the press was employed as their vehicle, could not remain altogether unknown in a country where the mathematical sciences were cultivated with zeal and diligence. Barrow, to whom they were first made known by the author himself, communicated them to Oldenburgh, the Secretary of the Royal Society, who had a very extensive correspondence all over Europe. By him the series for the quadrature of the circle were made known to James Gregory,[2] in Scotland, who had occupied himself very much with the same subject. They were also communicated to Leibnitz in Germany, who had become acquainted with Oldenburgh in a visit which he made to England in 1673. At the time of that visit, Leibnitz was but little conversant with the mathematics; but having afterwards devoted his great talents to the study of that science, he was soon in a condition to make new discoveries. He invented a method of squaring the circle, by transforming it into another curve of an equal area, but having the ordinate expressed by a rational fraction of the absciss, so that its area could be found by the methods already known. In this way he discovered the series, so remarkable for its simplicity, which gives the value of a circular arch in terms of the tangent. This series he communicated to Oldenburgh in 1674, and received from him in return an account of the progress made by Newton and Gregory in the invention of series. In 1676,

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[1] Wallis says, that he had inserted in the English edition of his book, published in 1685, several extracts from Newton's *Letters*, "*Omissis multis aliis inibi notatu dignis, eo quod speraverim clarissimum virum voluisse tum illa, tum alia quæ apud ipsum premit edidisse. Cum vero illud nondum fecerit libet eorum nonnulla hic attingere ne pereant.*" Among these last is an account of the fluxionary notation, according to which the fluxions of flowing quantities are distinguished by points, and also of certain applications of this new algorithm, extracted from two letters of Newton, written in 1792.—*Opera*, Tom. II. p. 390, &c. —There is no evidence of his notation having existed earlier than that date, though it be highly probable that it did.

[2] Note A, at the end.

Newton described his method of quadratures at the request of Oldenburgh, in order that it might be transmitted to Leibnitz in the two letters already mentioned, as of such value by recording the views which guided that great geometer in his earliest, and some of his most important discoveries. The method of fluxions is not communicated in these letters; nor are the principles of it in any way suggested; though there are, in the last letter, two sentences in transposed characters, which ascertain that Newton was then in possession of that method, and employed in speaking of it the same language in which it was afterwards made known. In the following year, Leibnitz, in a letter to Oldenburgh, introduces differentials, and the methods of his calculus for the first time. This letter,[1] which is very important, clearly proves that the author was then in full possession of the principles of his calculus; and had even invented the algorithm and notation.

From these facts, and they are all that bear directly on the question concerning the invention of the infinitesimal analysis, if they be fairly and dispassionately examined, I think that no doubt can remain, that Newton was the first inventor of that analysis, which he called by the name of Fluxions; but that, in the communications made by him, or his friends, to Leibnitz, there was nothing that could convey any idea of the principle on which that analysis was founded, or of the algorithm which it involved. The things stated were merely results; and though some of those relating to the tangents of curves might show the author to be in possession of a method of investigation different from infinite series, yet they afforded no indication of the nature of that method, or the principles on which it proceeded.

In what manner Newton's communications in the two letters already referred to, may have acted in stimulating the curiosity and extending or even directing the views of such a man as Leibnitz, I shall not presume to decide (nor even, if such effect be admitted, will it take from the originality of his discoveries); but that in the authenticated communications which took place between these philosophers, there was nothing which could make known the nature of the fluxionary calculus, I consider as a fact most fully established.

Of the new or infinitesimal analysis, we are, therefore, to consider Newton as the first inventor, Leibnitz as the second; his discovery, though posterior in time, having been made independently of the other, and having no less claim to origin-

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[1] *Commercium Epistolicum*, No. 66.

ality. It had the advantage also of being first made known to the world; an account of it, and of its peculiar algorithm, having been inserted in the first volume of the *Acta Eruditorum*, in 1684. Thus, while Newton's discovery remained a secret, communicated only to a few friends, the geometry of Leibnitz was spreading with great rapidity over the Continent. Two most able coadjutors, the brothers James and John Bernoulli, joined their talents to those of the original inventor, and illustrated the new methods by the solution of a great variety of difficult and interesting problems. The reserve of Newton still kept his countrymen ignorant of his geometrical discoveries, and the first book that appeared in England on the new geometry was that of Craig, who professedly derived his knowledge from the writings of Leibnitz and his friends. Nothing, however, like rivalship or hostility between these inventors had yet appeared; each seemed willing to admit the originality of the other's discoveries; and Newton, in the passage of the *Principia* just referred to, gave a highly favourable opinion on the subject of the discoveries of Leibnitz.

The quiet, however, that now prevailed between the English and German philosophers, was clearly of a nature to be easily disturbed. With the English was conviction, and, as we have seen, a well grounded conviction, that the first discovery of the Infinitesimal Analysis was the property of Newton; but the analysis thus discovered was yet unknown to the public, and was in the hands of the inventor and his friends. With the Germans, there was the conviction, also well founded, that the invention of their countryman was perfectly original; and they had the satisfaction to see his calculus everywhere adopted, and himself considered all over the Continent as the sole inventor. The friends of Newton could not but resist this latter claim, and the friends of Leibnitz, seeing that their master had become the great teacher of the new calculus, could not easily bring themselves to acknowledge that he was not the first discoverer. The tranquillity that existed under such circumstances, if once disturbed, was not likely to be speedily restored.

Accordingly, a remark of Fatio de Duillier, a mathematician, not otherwise very remarkable, was sufficient to light up a flame which a whole century has been hardly sufficient to extinguish. In a paper on the line of swiftest descent, which he presented to the Royal Society in 1699, was this sentence: "I hold Newton to have been the first inventor of this calculus, and the earliest, by several years, induced by the evidence of facts; and whether Leibnitz, the second inventor, has borrowed any thing from the other, I leave to the judgment of those who have seen the letters and manuscripts of Newton." Leibnitz replied to this charge in the Leipsic

Journal, without any asperity, simply stating himself to have been, as well as Newton, the inventor; neither contesting nor acknowledging Newton's claim to priority, but asserting his own to the first publication of the calculus.

Not long after this, the publication of Newton's *Quadrature of Curves*, and his *Enumeration of the lines of the third order* (1705), afforded the same journalists an opportunity of showing their determination to retort the insinuations of Duillier, and to carry the war into the country of the enemy. After giving a very imperfect synopsis of the first of these books, they add: "*Pro differentiis igitur Leibnitianis D. Newtonus adhibet, semperque adhibuit fluxiones; quæ sunt proxime ut fluentium augmenta, equalibus temporis particulis quam minimis genita; iisque tum in suis Principiis Naturæ Mathematicis, tum in aliis post editis, eleganter est usus; quamadmodum Honoratus Fabrius in sua Synopsi Geometricâ motuum progressus Cavalierianæ methodo substituit.*"[1]

In spite of the politeness and ambiguity[2] of this passage, the most obvious meaning appeared to be, that Newton had been led to the notion of fluxions by the differentials of Leibnitz, just as Honoratus Fabri had been led to substitute the idea of progressive motion for the indivisibles of Cavalieri. A charge so entirely unfounded, so inconsistent with acknowledged facts, and so little consonant to declarations that had formerly come from the same quarter, could not but call forth the indignation of Newton and his friends, especially as it was known, that these journalists spoke the language of Leibnitz and Bernoulli. In that indignation they were perfectly justified; but when the minds of contending parties have become irritated in a certain degree, it often happens that the injustice of one side is retaliated by an equal injustice from the opposite. Accordingly, Keill, who, with more zeal than judgment, undertook the defence of Newton's claims, instead of endeavouring to establish the priority of his discoveries, by an appeal to facts and to dates that could be accurately ascertained (in which he would have been completely successful), undertook to prove, that the communications of Newton to Leibnitz, were sufficient to put the latter in possession of the principles of the new analysis, after which he had only to substitute the notion of differentials for that of fluxions. In support of a charge which it would have required the clearest and most irresistible evidence to justify, he had, however, nothing to offer but equivocal facts and overstrained arguments, such as could only convince those

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[1] *Com. Epist.* No. 97. Newtoni *Opera*, Tom. IV. p. 577.

[2] Note B, at the end.

who were already disposed to believe. They were, accordingly, received as sound reasoning in England, rejected as absurd in Germany, and read with no effect by the mathematicians of France and Italy.

Leibnitz complained of Keill's proceeding to the Royal Society of London, which declined giving judgment, but appointed a commission of its members to draw up a full and detailed report of all the communications which had passed between Newton and Leibnitz, or their friends, on subjects connected with the new analysis, from the time of Collins and Oldenburgh to the date of Keill's letter to Sir Hans Sloane in 1711, the same that was now complained of. This report forms what is called the *Commercium Epistolicum;* it was published by order of the Royal Society the year following, and contains an account of the facts, which, though in the main fair and just, does not give that impression of the impartiality of the reporters which the circumstances so imperiously demanded. Leibnitz complained of this publication; and alleged, that though nothing might be inserted that was not contained in the original letters, yet certain passages were suppressed which were favourable to his pretensions. He threatened an answer, which, however, never appeared. Some notes were added to the *Commercium,* which contain a good deal of asperity and unsupported insinuation; the *Recensio,* or review of it, inserted in the *Philosophical Transactions* for 1715, though written with ability, is still more liable to the same censure.

In the year (1713) which followed the publication of the *Commercium Epistolicum,* a paragraph was circulated among the mathematicians of Europe, purporting to be the *judgment of a mathematician* on the invention of the new analysis. The author was not named, but was generally understood to be John Bernoulli, of which, indeed, the terms in which Leibnitz speaks of the judgment leaves no room to doubt. Bernoulli was without question well acquainted with the subject in dispute; he was a perfect master of the calculus; he had been one of the great instruments of its advancement, and, except impartiality, possessed every requisite for a judge. Without offence it might be said, that he could scarcely be accounted impartial. He had been a party in all that had happened;—warmly attached as he was to the one side, and greatly exasperated against the other, his temper had been more frequently ruffled, and his passions or prejudices more violently excited, than those of any other individual. With all his abilities, therefore, he was not likely to prove the fairest and most candid judge, in a cause that might almost be considered as his own. His sentence, however, is pronounced in calm and temperate language, and amounts to this, *That there is no reason to believe, that the fluxionary calculus was invented before the differential.*

I shall refer to a note[1] the discussion of the evidence which he points out as the ground of this decision, though the facts already stated might be considered as sufficient to enable the reader to form an opinion on the subject. The friends of Leibnitz hurt their own cause, by attempting to fix on Newton a charge of plagiarism, which was refuted by such a chain of evidence, by so many dates distinctly ascertained, and so many concessions of their own. A candid review of the evidence led to the conviction, that both Newton and Leibnitz were original inventors. When the English mathematicians accused Leibnitz of borrowing from Newton, they were, therefore, going much farther than the evidence authorized them, and were mistaking their own partialities for proofs. They maintained what was not true, but what, nevertheless, was not physically impossible, the discovery of Newton being certainly prior to that of Leibnitz. The German mathematicians, on the other hand, when they charged Newton with borrowing from Leibnitz, were maintaining what was not only false, but what involved an impossibility. This is the only part of the dispute, in which any thing that could be construed into *mala fides* can be said to have appeared. I am far, however, from giving it that construction; men of such high character, both for integrity and talents, as Leibnitz and Bernoulli, ought not to be lightly subjected to so cruel an imputation. Partiality, prejudice, and passion, are sufficient to account for much injustice, without a decided intention to do wrong.

In the state of hostility to which matters were now brought, the new analysis itself was had recourse to, as affording to either side abundant means of annoying its adversaries, by an inexhaustible supply of problems, accessible to those alone who were initiated in the doctrines, and who could command the resources of that analysis. The power of resolving such problems, therefore, seemed a test whether this analysis was understood or not. Already some questions of this kind had been proposed in the Leipsic *Journal*, not as defiances, but as exercises in the new geometry. Such was the problem of the *Catenaria*, or the curve, which a chain of uniform weight makes when suspended from two points. This had been proposed by Bernoulli in 1690; and had been resolved by Huygens, Leibnitz, and himself.

A question had been proposed, also, concerning the line of swiftest descent in 1697, or the line along which a body must descend, in order to go from one point to another not perpendicularly under it, in the least time possible. Though a straight line be the shortest distance between two points, it does not necessarily follow, that

[1] Note C, at the end.

the descent in that line will be most speedily performed, for, by falling in a curve that has at first a very rapid declivity, the body may acquire in the beginning of its motion so great a velocity, as shall carry it over a long line in less time than it would describe a short one, with a velocity more slowly acquired. This, however, is a problem that belongs to a class of questions of peculiar difficulty; and accordingly it was resolved only by a few of the most distinguished mathematicians. The solutions which appeared within the time prescribed were from Leibnitz, Newton, the two Bernoullis, and M. de l'Hopital. Newton's appeared in the *Philosophical Transactions* without a name; but the author was easily recognised. John Bernoulli, on seeing it, is said to have exclaimed, *Ex ungue leonem!*

The curve that has the property required is the cycloid; Newton has given the construction, but has not accompanied it with the analysis. He added afterwards the demonstration of a very curious theorem for determining the time of the actual descent. Leibnitz resolved the problem the same day that he received the *programme* in which it was proposed.

The problem of orthogonal trajectories, as it is called, had been long ago proposed in the *Acta Eruditorum*, with an invitation to all who were skilled in the new analysis to attempt the solution. The problem had not, at first, met with the attention it was supposed to deserve, but John Bernoulli having resumed the consideration of it, found out what appeared a very perfect and very general solution; and the question was then (1716) proposed anew by Leibnitz, for the avowed purpose of trying the skill of the English mathematicians. The question is, a system of curves described according to a known law being given (all the hyperbolas, for instance, that are described between the same assymptotes; or all the parabolas that have the same directrix, and that pass through the same point, &c.), to describe a curve which shall cut them all at right angles. This may be considered as the first defiance professedly aimed at the English mathematicians. The problem was delivered to Newton on his return from the Mint, when he was much fatigued with the business of the day; he resolved it, however, the same evening, and his solution, though without a name, is given in the *Philosophical Transactions* for 1716.[1]

This solution, however, only gave rise to new quarrels, for hardly any thing so excellent could come from the one side, that it could meet with the entire approbation of the other. Newton's, indeed, was rather the plan or *projet* of an in-

[1] Vol. XXIX. p. 399.

vestigation, than an actual solution; and, in the general view which it took of the question, could hardly provide against all the difficulties that might occur in the application to particular cases. This was what Bernoulli objected to, and affected to treat the solution as of no value. Brook Taylor, secretary of the Royal Society, and well known as one of the ablest geometers of the time, undertook the defence of it, but concluded with using language very reprehensible, and highly improper to be directed by one man of science against another. Having sufficiently, as he supposed, replied to Bernoulli and his friends, he adds, "if they are not satisfied with the solution, it must be ascribed to *their own ignorance*."[1] It strongly marks the temper by which both sides were now animated, when a man like Taylor, eminent for profound science, and, in general, very much disposed to do justice to the merits of others, should so forget himself as to reproach with ignorance of the calculus, one of the men who understood it the best, and who had contributed the most to its improvement. The irritability and prejudices of Bernoulli admitted of no defence, and he might very well have been accused of viewing the solution of Newton through a medium disturbed by their action; but to suppose that he was unable to understand it, was an impertinence that could only react on the person who was guilty of it. Bernoulli was not exemplary for his patience, and it will be readily believed, that the incivility of Taylor was sufficiently revenged. It is painful to see men of science engaged in such degrading altercation, and I should be inclined to turn from so disagreeable an object, if the bad effects of the spirit thus excited were not such as must again obtrude themselves on the notice of the reader.

Taylor not long after came forward with an open defiance to the whole Continent, and proposed a problem, *Omnibus geometris non Anglis*,—a problem, of course, which he supposed that the English mathematicians alone were sufficiently enlightened to resolve. He selected one, accordingly, of very considerable difficulty,—the integration of a fluxion of a complicated form; which, nevertheless, admitted of being done in a very elegant manner, known, I believe, at that time to very few of the English mathematicians, to Cotes, to himself, and, perhaps, one or two more. The selection, nevertheless, was abundantly injudicious; for Bernoulli, as long ago as 1702, had explained the method of integrating this, and such like formulas, both in the *Paris Memoires* and in the *Leipsic Acts*. The question, accordingly, was no sooner proposed than it was answered in a manner the most clear and satisfactory; so the

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[1] Eorum imperitiæ tribuendum est.

defiance of Taylor only served to display the address and augment the triumph of his adversary.

The last and most unsuccessful of these challenges was that of Keill, of whose former appearance in this controversy we have already had so much more reason to commend the zeal than the discretion. Among the problems in the mixt mathematics which had excited most attention, and which seemed best calculated to exercise the resources of the new analysis, was the determination of the path of a projectile in a medium which resists proportionally to the square of the velocity, that being nearly the law of the resistance which the air opposes to bodies moving with great velocity. The resistance of fluids had been treated of by Newton in the second book of the *Principia*, and he had investigated a great number of curious and important propositions relative to its effects. He had considered some of the simpler laws of resistance, but of the case just mentioned he had given no solution, and, after approaching as near as possible to it on all sides, had withdrawn without making an attack. A problem so formidable was not likely to meet with many who, even in the more improved state at which the calculus had now arrived, could hope to overcome its difficulties. Whether Keill had flattered himself that he could resolve the problem, or had forgotten, that when a man proposes a question of defiance to another, he ought to be sure that he can answer it himself, may be doubted; but this is certain, that, without the necessary preparation, he boldly challenged Bernoulli to produce a solution.

Bernoulli resolved the question in a very short time, not only for a resistance proportional to the square, but to any power whatsoever of the velocity, and by the conditions which he affixed to the publication of his solution, took care to expose the weakness of his antagonist. He repeatedly offered to send his solution to a confidential person in London, providing Keill would do the same. Keill never made any reply to a proposal so fair, that there could only be one reason for declining it. Bernoulli, of course, exulted over him cruelly, breaking out in a torrent of vulgar abuse, and losing sight of every maxim of candour and good taste.

Such, then, were the circumstances under which the infinitesimal analysis,—the greatest discovery ever made in the mathematical sciences,—was ushered into the world. Every where, as it became known, it enlarged the views, roused the activity, and increased the power of the geometer, while it directed the warmest sentiments of his gratitude and admiration toward the great inventors. In one respect, only, its effects were different from those which one would have wished to see produced. It

excited jealousy between two great men who ought to have been the friends of one another, and disturbed in both that philosophic tranquillity of mind, for the loss of which even glory itself is scarcely an adequate recompense.

In order to form a correct estimate of the magnitude and value of this discovery, it may be useful to look back at the steps by which the mathematical sciences had been prepared for it. When we attempt to trace those steps to their origin, we find the principle of the infinitesimal analysis making its first appearance in the method of Exhaustions, as exemplified in the writings of Euclid and Archimedes. These geometers observed, and, for what we know, were the first to observe, that the approach which a rectilineal figure may make to one that is curvilineal, by the increase of the number of its sides, the diminution of their magnitude, and a certain enlargement of the angles they contain, may be such that the properties of the former shall coincide so nearly with those of the latter, that no real difference can be supposed between them without involving a contradiction; and it was in ascertaining the conditions of this approach, and in showing the contradiction to be unavoidable, that the method of Exhaustions consisted. The demonstrations were strictly geometrical, but they were often complicated, always indirect, and of course synthetical, so that they did not explain the means by which they had been discovered.

At the distance of more than two thousand years, Cavalieri advanced a step farther, and, by the sacrifice of some apparent, though of no real accuracy, explained, in the method of indivisibles, a principle which could easily be made to assume the more rigid form of Exhaustions. This was a very important discovery;—though the process was not analytical, the demonstrations were direct, and, when applied to the same subjects, led to the same conclusions which the ancient geometers had deduced; by an indirect proof also, such as those geometers had adopted, it could always be shown that an absurdity followed from supposing the results deduced from the method of indivisibles to be other than rigorously true.

The method of Cavalieri was improved and extended by a number of geometers of great genius who followed him; Torricelli, Roberval, Fermat, Huygens, Barrow, who all observed the great advantage that arose from applying the general theorems concerning variable quantity to the cases where the quantities approached to one another infinitely near, that is, nearer than within any assigned difference.[1] There

[1] Note D, at the end.

was, however, as yet, no calculus adapted to these researches, that is, no general method of reasoning by help of arbitrary symbols.

But we must go back a step, in point of time, if we would trace accurately the history of this last improvement. Descartes, as has been shown in the former part of this outline, made a great revolution in the mathematical sciences, by applying algebra to the geometry of curves; or, more generally, by applying it to express the relations of variable quantity. This added infinitely to the value of the algebraic analysis, and to the extent of its investigations. The same great mathematician had observed the advantage that would be gained in the geometry of curves, by considering the variable quantities in one state of an equation as differing infinitely little from the corresponding quantities in another state of the same equation. By means grounded on this he had attempted to draw tangents to curves, and to determine their curvature; but it is seldom the destination of Nature that a new discovery should be begun and perfected by the same individual; and, in these attempts, though Descartes did not entirely fail, he cannot be considered as having been successful.[1]

At last came the two discoverers, Newton and Leibnitz, who completely lifted up the veil which their predecessors had been endeavouring to draw aside. They plainly saw, as Descartes indeed had done in part, that the infinitely small variations of the ordinate and absciss are closely connected with many properties of the curve, which have but a very remote dependence on the ordinates and abscissæ themselves. Hence they inferred, that, to obtain an equation expressing the relations of these variations to one another, was to possess the most direct access to the knowledge of those properties. They observed also, that when an equation of this kind was deduced from the general equation, it admitted of being brought to great simplicity, and of being resolved much more readily than the other. In effect, it assumed the form of a simple equation; but, in order to make this deduction in the readiest and most distinct way, the introduction of new symbols, or of a new algorithm, was necessary, the invention of which could cost but little to the creative genius of the men of whom I now speak. They appear, as has been already shown, to have made their discoveries separately;—Newton first,—Leibnitz afterwards, at a considerable interval, yet the earliest, by several years, in communicating his discoveries to the world.

Thus, though there had been for ages a gradual approach to the new analysis, there were in that progress some great and sudden advances which elevated those who made

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[1] Dissert. Second, Part I. p. 18.

them to a much higher level than their predecessors. A great number of individuals co-operated in the work; but those who seem essential, and in the direct line of advancement, are Euclid, Cavalieri, Descartes, Newton and Leibnitz. If any of the others had been wanting, the world would have been deprived of many valuable theorems, and many collateral improvements, but not of any general method essential to the completion of the infinitesimal analysis.

The views, however, of this analysis taken by the two inventors were not precisely the same. Leibnitz, considering the differences of the variable quantities as infinitely small, conceived that he might reject the higher powers of those differences without any sensible error; so that none of those powers but the first remained in the differential equation finally obtained. The rejection, however, of the higher powers of the differentials was liable to objection, for it had the appearance of being only an approximation, and did not come up to the perfect measure of geometrical precision. The analysis, thus constituted, necessarily divided itself into two problems;—the first is,—having given an equation involving two or more variable quantities, to find the equation expressing the relation of the differentials, or infinitely small variations of those quantities; the second is the converse of this;—having given an equation involving two or more variable quantities, and their differentials, to exterminate the differentials, and so to exhibit the variable quantities in a finite state. This last process is called *integration* in the language of the differential analysis, and the finite equation obtained is called the *integral* of the given differential equation.

Newton proceeded in some respects differently, and so as to preserve his calculus from the imputation of neglecting or throwing away any thing merely because it was small. Instead of the actual increments of the flowing or variable quantities, he introduced what he called the fluxions of those quantities,—meaning, by fluxions, quantities which had to one another the same ratio which the increments had in their ultimate or evanescent state. He did not reject quantities, therefore, merely because they were so small that he *might* do so without committing any sensible error, but because he *must* reject them, in order to commit no error whatsoever. Fluxions were, with him, nothing else than measures of the velocities with which variable or flowing quantities were supposed to be generated, and they might be of any magnitude, providing they were in the ratio of those velocities, or, which is the same, in the ratio of the nascent or evanescent increments.[1] The

[1] "I consider mathematical quantities in this place not as consisting of small parts, but as described by a

fluxions, therefore, and the flowing quantities or fluents of Newton correspond to the differentials and the sums or integrals of Leibnitz; and though the symbols which denote fluxions are different from those used to express differentials, they answer precisely the same purpose. The fluxionary and differential calculus may therefore be considered as two modifications of one general method, aptly distinguished by the name of the *infinitesimal analysis.*

By the introduction of this analysis, the domain of the mathematical sciences was incredibly enlarged in every direction. The great improvement which Descartes had made by the application of algebraic equations to define the nature of curve lines was now rendered much more efficient, and carried far beyond its original boundaries. From the equation of the curve the new analysis could deduce the properties of the tangents, and, what was much more difficult, could go back from the properties of the tangents to the equation of the curve. From the same equation it was able to determine the curvature at every point; it could measure the length of any portion of the curve or the area corresponding to it. Nor was it only to algebraic curves that those applications of the calculus extended, but to curves transcendental and mechanical, as in the instances of the catenaria, the cycloid, the elastic curve, and many others. The same sort of research could be applied to curve surfaces described according to any given law, and also to the solids contained by them.

The problems which relate to the *maxima* and *minima*, or the greatest and least values of variable quantities, are among the most interesting in the mathematics; they are connected with the highest attainments of wisdom and the greatest exertions of power; and seem like so many immoveable columns erected in the infinity of space, to mark the eternal boundary which separates the regions of possibility and impossibility from one another. For the solution of these problems, a particular provision seemed to be made in the new geometry.

When any function becomes either the greatest or the least, it does so by the velocity of its increase or of its decrease ceasing entirely, or, in the language of algebra, becoming equal to nothing. But when the velocity with which the function varies becomes nothing, the fluxion which is proportional to that velocity must become nothing also. Therefore, it is only necessary to take the fluxion of the given function, and by supposing it equal to nothing, an equation will be obtained in finite terms

continued motion. Lines are described and thereby generated, not by the apposition of parts, but by the continued motion of points, superficies by the motion of lines," &c.—*Quadrature of Curves*, Introduction.

(for the fluxion will entirely disappear), expressing the relation of the quantities when the function assigned is the greatest or the least possible.

Another kind of maximum or minimum, abounding also in interesting problems, is more difficult by far than the preceding, and, when taken generally, seems to be only accessible to the new analysis. Such cases occur when the function of the variable quantities which is to be the greatest or the least is not given, but is itself the thing to be found; as when it is proposed to determine the line by which a heavy body can descend in the least time from one point to another. Here the equation between the co-ordinates of the curve to be found is, of course, unknown, and the function of those co-ordinates which denotes the time of descent cannot therefore be algebraically expressed, so that its fluxion cannot be taken in the ordinary way, and thus put equal to nothing. The former rule, then, is not applicable in such cases, and it is by no means obvious in what manner this difficulty is to be overcome. The general problem exercised the ingenuity of both the Bernoullis, as it has since done of many other mathematicians of the greatest name. As there are in such problems always two conditions, according to the first of which, a certain property is to remain constant, or to belong to all the individuals of the species, and, according to the second, another property is to be the greatest or the least possible; and as, in some of the simplest of such questions, [1] the constant quantity is the circumference or perimeter of a certain curve, so problems of this kind have had the name of *Isoperimetrical* given them, a term which has thus come to denote one of the most curious and difficult subjects of mathematical investigation.

The new analysis, especially according to the view taken of it by Newton, is peculiarly adapted to physical researches, as the hypothesis of quantities being generated by continued motion, comes there to coincide exactly with the fact. The momentary increments or the fluxions represent so precisely the forces by which the changes in nature are produced, that this doctrine seemed created for the express purpose of penetrating into the interior of things, and taking direct cognizance of those animating powers which, by their subtility, not only elude the observation of sense, but the ordinary methods of geometrical investigation. The infinitesimal analysis alone affords the means of measuring forces, when each acts separately, and instan-

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[1] The most simple problem of the kind is strictly and literally *Isoperimetrical*, viz. of all curves having the same perimeter to find that which has the greatest area. Elementary geometry had pronounced this curve to be the circle long before there was any idea of an entire class of problems characterized by similar conditions. *Vid. Pappi Alexandrini Collect. Math.* Lib. V. Prop. 2. &c.

taneously under conditions that can be accurately ascertained. In comparing the effects of continued action, the variety of time and circumstance, and the continuance of effects after their causes have ceased, introduce so much uncertainty, that nothing but vague and unsatisfactory conclusions can be deduced. The analysis of infinites goes directly to the point; it measures the intensity or instantaneous effort of the force, and, of course, removes all those causes of uncertainty which prevailed when the results of *continued* action could alone be estimated. It is not even by the effects produced in a short time, but by effects taken in their *nascent* or *evanescent* state, that the true proportion of causes must be ascertained.

Thus, though the astronomers had proved that the planets describe ellipses round the sun as the common focus, and that the line from the sun to each planet sweeps over areas proportional to the time; had not the geometer resolved the elliptic motion into its primary elements, and compared them in their state of evanescence, it would never have been discovered that these bodies gravitate to the sun with forces which are inversely as the square of their distances from the centre of that luminary. Thus, fortunately, the first discovery of Newton was the instrument which was to conduct him safely through all the intricacies of his future investigations.

The calculus, as already remarked, necessarily divides itself into two branches; one which, from the variable quantities, finds the relation of their fluxions or differentials; another which, from the relation of these last, investigates the relation of the variable quantities themselves. The first of these problems is always possible, and, in general, easy to be resolved; the second is not always possible, and when possible, is often very difficult, but in various degrees, according to the manner in which the differentials and the variable quantities are combined with one another.

If the function, into which the differential stands multiplied, consist of a single term, or an aggregate of terms, in each of which the variable quantity is raised to a power expounded by a number positive, negative, or fractional, the integration can be effected with ease, either in algebraic or logarithmic terms; and the calculus had not been long known before this problem was completely resolved.

The second case of this first division is, when the given function is a fraction having a binomial or multinomial denominator, the terms of which contain any powers whatever of the variable magnitude, but without involving the radical sign. If the denominator contain only the simple power of the variable quantity, the integral is easily found by logarithms; i f it be complex, it must be resolved either into simple or quadratic divisors, which, granting the solution of equations, is always

possible, at least by approximation, and the given fraction is then found equal to an aggregate of simple fractions, having these divisors for their denominators, and of which the fluents can always be exhibited in algebraic terms, or in terms of logarithms and circular arches. This very general and important problem was resolved by J. Bernoulli as early as the year 1702.

The denominator is in this last case supposed rational; but if it be irrational, the integration requires other means to be employed. Here Leibnitz and Bernoulli both taught, how, by substitutions, as in *Diophantine* problems, the irrationality might be removed, and the integration of course reduced to the former case. Newton employed a different method, and, in his *Quadrature of Curves*, found the fluents, by comparing the given fluxion with the formulas immediately derived from the expression of circular or hyperbolic areas. The integrations of these irrational formulæ, whichever of the methods be employed, often admit of being effected with singular elegance and simplicity; but a general integration of all the formulæ of this kind, except by approximation, is not yet within the power of analysis.

The second general division of the problem of integration, viz. when the two variable quantities and their differentials are mixed together on each side of the equation, is a more difficult subject of inquiry than the preceding. It may indeed happen, that an equation, which at first presents itself under this aspect, can, by the common rules of algebra, have the quantities so separated, that on each side of the sign of equality there shall be but one variable quantity with its fluxion; and when this is done, the integration is reduced to one of the cases already enumerated.

When such separation cannot be made, the problem is among the most difficult which the infinitesimal analysis presents, at the same time that it is the key to a vast number of interesting questions both in the pure and the mixed mathematics. The two Bernoullis applied themselves strenuously to the elucidation of it; and to them we owe all the best and most accurate methods of resolving such questions which appeared in the early history of the calculus, and which laid the foundation of so many subsequent discoveries. This is a fact which cannot be contested; and it must be acknowledged also, that, on the same subject, the writings of the English mathematicians were then, as they continue to be at this day, extremely defective. Newton, though he had treated of this branch of the infinitesimal analysis with his usual ingenuity and depth, had done so only in his work on *Fluxions*, which did not see the light till several years after his death, when, in 1736, it appeared in Colson's translation. But that work, even had it come into the hands of the public in the author's lifetime,

would not have remedied the defect of which I now speak. When the fluxionary equation could not be integrated by the simplest and most elementary rules, Newton had always recourse to approximations by infinite series, in the contrivance of which he indeed displayed great ingenuity and address. But an approximation, let it be ever so good, and converge ever so rapidly, is always inferior to an accurate and complete solution, if this last possess any tolerable degree of simplicity. The series which affords the approximation cannot converge always, or in all states of the variable quantity; and its utility, on that account, is so much limited, that it can hardly lead to any general result. Besides, it does not appear that these series can always be made to involve the arbitrary or indeterminate quantity, without which no fluent can be considered as complete. For these reasons, such approximations should never be resorted to till every expedient has been used to find an accurate solution. To this rule, however, Newton's method does not conform, but employs approximation in cases where the complete integral can be obtained. The tendency of that method, therefore, however great its merit in other respects, was to give a direction to research which was not always the best, and which, in many instances, made it fall entirely short of the object it ought to have attained. It is true, that many fluxionary equations cannot be integrated in any other way; but by having recourse to it indiscriminately, we overlook the cases in which the integral can be exactly assigned. Accordingly, Bernoulli, by following a different process, remarked entire classes of fluxionary or differential equations, that admitted of accurate integration. Thus he found, that differential equations, if homogeneous,[1] however complicated, may always have the variable quantities separated, so as to come under one of the simpler forms already enumerated. By the introduction, also, of exponential equations, which had been considered in England as of little use, he materially improved this branch of the calculus.

To all these branches of analysis we have still another to add of indefinite extent, arising out of the consideration of the fluxions or differentials of the higher orders, each of these orders being deduced from the preceding, just as first fluxions are from the variable quantities to which they belong. To understand this, conceive the successive values of the first fluxions of any variable quantity, to constitute a new series of variable quantities flowing with velocities, the measures of which form the

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[1] Homogeneous equations in the differential calculus, are those in which the sum of the exponents of the variable quantities is the same in all the terms.

fluxions of the second order, from which, in the same manner, are deduced fluxions of the third and of still higher orders. The general principles are the same as in the fluxions of the first order, but the difficulties of the calculus are greater, particularly in the integrations; for to rise from second fluxions to the variable quantities themselves two integrations are necessary; from third fluxions three, and so on.

The tract which first made known the new analysis was that of Leibnitz, published, as already remarked, in the first volume of the *Acta Eruditorum* for 1684, where it occupies no more than six pages,[1] and is the work of an author not yet become very familiar with the nature of his own invention. It was sufficient, however, to explain that invention to mathematicians; but, nevertheless, some years elapsed before it drew much attention. The Bernoullis were the first who perceived its value, and made themselves masters of the principles and methods contained, or rather suggested, in it. Leibnitz published many other papers in the *Acta Eruditorum* and the journals of the times, full of original views and important hints, thrown out very briefly, and requiring the elucidations which his friends just mentioned were always so willing and so able to supply. The number of literary and scientific objects which divided the attention of the author himself was so great, that he had not time to bestow on the illustration and developement of the most important of his own discoveries, and the new analysis, for all that he has taught, would have been very little known, and very imperfectly unfolded, if the two excellent geometers just named had not come to his assistance. Their tracts were also, like his, scattered in the different periodic works of that time, and several years elapsed before any elementary treatise explained the general methods, and illustrated them by examples. The first book in which this was done, so far at least as concerned the differential or direct calculus, was the *Analyse des Infiniment Petits* of the *Marquis de l'Hôpital*, published in 1696, a work of great merit, which did much to diffuse the knowledge of the new analysis. It was well received at that time, and has maintained its character to the present day. The author, a man of genius, indefatigable and ardent in the pursuits of science, had enjoyed the *viva voce* instructions of John Bernoulli, on the subject of the new geometry, and therefore came forward with every possible advantage.

It was long after this before the works of the Bernoullis were collected together,

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[1] *Nova Methodus pro Maximis et Minimis*, &c. Leibnitii *Opera*, Tom. III. p. 167.

those of James in two quarto volumes, and of John in four.[1] In the third of these last volumes is a tract of considerable length, with the title of *Lectiones de Methodo Integralium*, written in 1691 and 1692, for the use of M. de l'Hôpital, to whose book on the differential calculus it seems to have been intended as a sequel. It is a work of great merit; and affords a distinct view of many of the most general methods of integration, with their application to the most interesting problems; so that, though the earliest treatise on that subject, it remains at this day one of the best compends of the new analysis of which the mathematical world is in possession. Indeed, the whole of the volumes just referred to are highly interesting, as containing the original germs of the new analysis, and as being the work of men always inspired by genius, sometimes warmed by opposition, and generally animated by the success which accompanied their researches.

But we must now look at the original works of the earliest inventor. Newton, besides his letters published in the *Commercium Epistolicum*, is the author of three tracts on the new analysis that have all been occasionally mentioned. None of them, however, appeared nearly so soon as a great number of the pieces which have just been enumerated. The *Quadrature of Curves*, written as early as 1665 or 1666, did not appear till 1704; and though it be a treatise of great value, and containing very important and very general theorems concerning the quadrature of curves, it must be allowed, that it is not well adapted to make known the spirit and the views of the infinitesimal analysis. After a short introduction, which is indeed analytical, and which explains the idea of a fluxion with great brevity and clearness, the treatise sets out with proposing to find any number of curves that can be squared; and here the demonstrations become all synthetical, without any thing that may be properly called analytical investigation. By synthetical demonstrations I do not mean reasonings where the algebraic language is not used, but reasonings, whatever language be employed, where the solution of the proposed question is first laid down, and afterwards demonstrated to be true. Such is the method pursued throughout this work, and it is wonderful how many valuable conclusions concerning the areas of curves, and their reduction to the areas of the circle and hyperbola, are in that manner deduced. But though truths can be very well conveyed in the synthetical way, the methods of investigating truth are not communicated by it, nor the powers of invention directed to

[1] Those of James were published at Geneva in 1744; of John at Lausanne and Geneva in 1742.

their proper objects. As an elementary treatise on the new analysis, the *Quadrature of Curves* is therefore imperfect, and not calculated, without great study, to give to others any portion of the power which the author himself has exerted. The problem of finding fluents, though it be that on which the whole quadrature of curves depends, is entirely kept out of view, and never once proposed in the course of a work, which, at the same time, is full of the most elaborate and profound reasonings.

Newton had a great fondness for the synthetical method, which is apparent even in the most analytical of his works. In his *Fluxions,* when he is treating of the quadrature of curves, he says, "After the area of a curve has been found and constructed, we should consider about the demonstration of the construction, that, laying aside all algebraical calculation, as much as may be, the theorem may be adorned and made elegant, so as to become fit for public view."[1] This is followed by two or three examples, in which the rule here given is very happily illustrated. When the analysis of a problem requires, like the quadrature of curves, the use of the inverse method of fluxions, the reversion of that analysis, or the synthetical demonstration, must proceed by the direct method, and therefore may admit of more simplicity than the others, so as, in the language of the above passage, to be easily adorned and made elegant.

The book of *Fluxions* is, however, an excellent work, entering very deeply into the nature and spirit of the calculus,—illustrating its application by well chosen examples,—and only failing, as already said, by having recourse, for finding the fluents of fluxionary equations, too exclusively to the method of series, without treating of the cases in which exact solutions can be obtained.

Of the works that appeared in the early stages of the calculus, none is more entitled to notice than the *Harmonia Mensurarum* of Cotes. The idea of reducing the areas of curves to those of the circle and hyperbola, in those cases which did not admit of an accurate comparison with rectilineal spaces, had early occurred to Newton, and was very fully exemplified in his *Quadrature of Curves.* Cotes extended this method :—his work appeared in 1722, and gave the rules for finding the fluents of fractional expressions, whether rational or irrational, greatly generalized and highly improved by means of a property of the circle discovered by himself, and justly reckoned among the most remarkable propositions in geometry. It is singular that a work

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[1] Newton's *Fluxions,* Colson's Translation, p. 116, § 107.

so profound, and so useful as the *Harmonia Mensurarum*, should never have acquired, even among the mathematicians of England, the popularity which it deserves; and that, on the Continent, it should be very little known, even after the excellent commentary and additions of Bishop Walmsley. The reasons, perhaps, are, that, in many parts, the work is obscure; that it does not explain the analysis which must have led to the *formulæ* contained in the tables; and that it employs an unusual language and notation, which, though calculated to keep in view the analogy between circular and hyperbolic areas, or between the measures of angles and of ratios, do not so readily accommodate themselves to the business of calculation as those which are commonly in use. Demoivre, a very skilful and able mathematician, improved the method of Cotes; and explained many things in a manner much more clear and analytical than had hitherto been done.[1]

Another very original and profound writer of this period was Brook Taylor, who has already been often mentioned, and who, in his *Method of Increments*, published in 1715, added a new branch to the analysis of variable quantity. According to this method, quantities are supposed to change, not by infinitely small, but by finite increments, or such as may be of any magnitude whatever. There are here, therefore, as in the case of fluxions or differentials, two general questions: A function of a variable quantity being given, to find the expression for the finite increment of that function, the increment of the variable quantity itself being a finite magnitude. This corresponds to the direct method of fluxions; the other question corresponds to the inverse, viz. A function being given containing variable quantities, and their increments any how combined, to find the function from which it is derived. The author has considered both these problems, and in the solution of the second, particularly, has displayed much address. He has also made many ingenious applications of this calculus both to geometrical and physical questions, and, above all, to the summation of series, a problem for the solution of which it is peculiarly adapted.

Taylor, however, was more remarkable for the ingenuity and depth, than for the perspicuity of his writings; even a treatise on *Perspective*, of which he is the author, though in other respects excellent, has always been complained of as obscure; and it is no wonder if, on a new subject, and one belonging to the higher geometry, his

[1] Demoivre, *Miscellanea Analytica.* See also the work of an anonymous author, *Epistola ad Amicum de Cotesii Inventis.*

writings should be still more exposed to that reproach. This fault was removed, and the whole theory explained with great clearness, by M. Nicol, of the Academy of Sciences of Paris, in a series of *Memoires* from the year 1717 to 1727.

A single analytical formula in the *Method of Increments* has conferred a celebrity on its author, which the most voluminous works have not often been able to bestow. It is known by the name of Taylor's Theorem, and expresses the value of any function of a variable quantity in terms of the successive orders of increments, whether finite or infinitely small. If any one proposition can be said to comprehend in it a whole science it is this: for from it almost every truth and every method of the new analysis may be deduced. It is difficult to say, whether the theorem does most credit to the genius of the author, or the power of the language which is capable of concentrating such a vast body of knowledge in a single expression. Without an acquaintance with algebra, it is impossible, I believe, to conceive the manner in which this effect is produced.

By means of its own intrinsic merit, and the advantageous display of it made in the works now enumerated, the new analysis, long before the expiration of the period of which I am here treating, was firmly established all over Europe. It did not, however, exist everywhere in the same condition, nor under the same form; with the British and Continental mathematicians, it was referred to different origins; it was in different states of advancement; the notation and some of the fundamental ideas were also different. The authors communicated little with one another, except in the way of defiance or reproach; and, from the angry or polemical tone which their speculations often assumed, one could hardly suppose, that they were pursuing science in one of its most abstract and incorporeal forms.

Though the algorithm employed, and the books consulted on the new analysis, were different, the mathematicians of Britain and of the Continent had kept pace very nearly with one another during the period now treated of, except in one branch, the integration of differential or of fluxional equations. In this, our countrymen had fallen considerably behind, as has been already explained; and the distance between them and their brethren on the Continent continued to increase, just in proportion to the number and importance of the questions, physical and mathematical, which were found to depend on these integrations. The habit of studying only our own authors on these subjects, produced at first by our admiration of Newton and our dislike to his rivals, and increased by a circumstance very insignificant in itself, the diversity of notation, prevented us from

partaking in the pursuits of our neighbours; and cut us off in a great measure from the vast field in which the genius of France, of Germany, and Italy, was exercised with so much activity and success. Other causes may have united in the production of an effect, which the mathematicians of this country have had much reason to regret; but the evil had its origin in the spirit of jealousy and opposition, which arose from the controversies that have just passed under our review. The habits so produced continued long after the spirit itself had subsided.

It must not be supposed, that so great a revolution in science, as that which was made by the introduction of the new analysis, could be brought about entirely without opposition, as in every society there are some who think themselves interested to maintain things in the condition wherein they have found them. The considerations are indeed sufficiently obvious, which, in the moral and political world, tend to produce this effect, and to give a stability to human institutions, often so little proportionate to their real value or to their general utility. Even in matters purely intellectual, and in which the abstract truths of arithmetic and geometry seem alone concerned, the prejudices, the selfishness, or vanity of those who pursue them, not unfrequently combine to resist improvement, and often engage no inconsiderable degree of talent in drawing back instead of pushing forward the machine of science. The introduction of methods entirely new must often change the relative place of the men engaged in scientific pursuits; and must oblige many, after descending from the stations they formerly occupied, to take a lower position in the scale of intellectual advancement. The enmity of such men, if they be not animated by a spirit of real candour and the love of truth, is likely to be directed against methods, by which their vanity is mortified, and their importance lessened. Though such changes as this must have everywhere accompanied the ascendancy acquired by the calculus, for the credit of mathematicians it must be observed, that no one of any considerable eminence has had the misfortune to enrol his name among the adversaries of the new science; and that Huygens, the most distinguished and most profound of the older mathematicians then living, was one of the most forward to acknowledge the excellence of that science, and to make himself master of its rules, and of their application.

Nevertheless, certain adversaries arose successively in Germany, France, and England, the countries in which the new methods first became known.

Nieuentit, an author commendable as a naturalist, and as a writer on morals, but a very superficial geometer, aimed the first blow at the Differential Calculus. He ob-

jected to the explanation of Leibnitz, and to the notion of quantities infinitely small.[1] It seemed as if he were unwilling to believe in the reality of objects smaller than those discovered by his own microscope, and were jealous of any one who should come nearer to the limit of extension than he himself had done. Leibnitz thought his objections not undeserving of a reply; but the reply was not altogether satisfactory. A second was given with better success; and afterwards Herman and Bernoulli each severally defeated an adversary, who was but very ill able to contend with either of them.

Soon after this, the calculus had to sustain an attack from two French academicians, which drew more attention than that of the Dutch naturalist. One of these, Rolle, was a mathematician of no inconsiderable acquirement, but whose chief gratification consisted in finding out faults in the works of others. He founded his objections to the differential calculus, not on the score of principles or of general methods, but on certain cases which he had sought out with great industry, in which those methods seemed to him to lead to false and contradictory conclusions. On examination, however, it turned out, that in every one of those instances the error was entirely his own; that he had misapplied the rules, and that his eagerness to discover faults had led him to commit them. His errors were detected and pointed out with demonstrative evidence by Varignon, Saurin, and some others, who were among the first to perceive the excellence and to defend the solidity of the new geometry. These disputes were of consequence enough to occupy the attention of the Academy of Sciences during a great part of the year 1701.

The Abbé Gallois joined with Rolle in his hostility to the calculus, and though he added very little to the force of the attack, he kept the field after the other had retired from the combat. Fontenelle, in his *Eloge* on the Abbé, has given an elegant turn to the apology he makes for him.—" His taste for antiquity made him suspicious of the geometry of infinites. He was, in general, no friend to any thing that was new, and was always prepared with a kind of *Ostracism* to put down whatever appeared too conspicuous for a free state like that of letters. The geometry of infinites had both these faults, and particularly the latter."

After all these disputes were quieted in France, and the new analysis appeared completely victorious, it had an attack to sustain in England from a more formi-

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[1] He published *Analysis Infinitorum* at Amsterdam, in 1695; and another tract, *Considerationes circa Calculi Differentialis Principia,* in the year following. This last was answered by Herman.

dable quarter. Berkeley Bishop of Cloyne, was a man of first-rate talents, distinguished as a metaphysician, a philosopher, and a divine. His geometrical knowledge, however, which, for an attack on the method of fluxions, was more essential than all his other accomplishments, seems to have been little more than elementary. The motive which induced him to enter on discussions so remotely connected with his usual pursuits has been variously represented; but, whatever it was, it gave rise to the *Analyst*, in which the author professes to demonstrate, that the new analysis is inaccurate in its principles, and that, if it ever lead to true conclusions, it is from an accidental compensation of errors that cannot be supposed always to take place. The argument is ingeniously and plausibly conducted, and the author sometimes attempts ridicule with better success than could be expected from the subject; thus, when he calls ultimate ratios the *ghosts of departed quantities*, it is not easy to conceive a witty saying more happily fastened on a mere mathematical abstraction.

The *Analyst* was answered by Jurin, under the signature of *Philalethes;* and to this Berkeley replied in a tract entitled *A Defence of Freethinking in Mathematics.* Replies were again made to this, so that the argument assumed the form of a regular controversy; in which, though the defenders of the calculus had the advantage, it must be acknowledged that they did not always argue the matter quite fairly, nor exactly meet the reasoning of their adversary. The true answer to Berkeley was, that what he conceived to be an accidental compensation of errors was not at all accidental, but that the two sets of quantities that seemed to him neglected in the reasoning were in all cases necessarily equal, and an exact balance for one another. The Newtonian idea of a fluxion contained in it this truth, and so it was argued by Jurin and others, but not in a manner so logical and satisfactory as might have been expected. Perhaps it is not too much to assert, that this was not completely done till La Grange's *Theory of Functions* appeared. Thus, if the author of the *Analyst* has had the misfortune to enrol his name on the side of error, he has also had the credit of proposing difficulties of which the complete solution is only to be derived from the highest improvements of the calculus.

This controversy made some noise in England, but I do not think that it ever drew much attention on the Continent. The *Analyst,* I imagine, notwithstanding its acuteness, never crossed the Channel. Montucla evidently knows it only by report, and seems as little acquainted with the work as with its author, of whom he speaks very slightly, and supposes he has sufficiently described him by saying, that he has written a book against the existence of matter, and another in praise of tar-water. But it is

less from the opinions which men support than from the manner in which they support them, that their talents are to be estimated. If we judge by this criterion, we shall pronounce Berkeley to be a man of genius, whether he be employed in attacking the infinitesimal analysis, in disproving the existence of the external world, or in celebrating the virtues of tar-water.[1]

Section II.

MECHANICS, GENERAL PHYSICS, &c.

The discoveries of Galileo, Descartes, and other mathematicians of the seventeenth century, had made known some of the most general and important laws which regulate the phenomena of moving bodies. The inertia, or the tendency of body, when left to itself, to preserve unchanged its condition either of motion or of rest; the effect of an impulse communicated to a body, or of two simultaneous impulses, had been carefully examined, and had led to the discovery of the composition of motion. The law of equilibrium, not in the lever alone, but in all the mechanical powers, had been determined, and the equality of action to reaction, or of the motion lost to the motion acquired, had not only been established by reasoning, but confirmed by experiment. The fuller elucidation and farther extension of these principles were reserved for the period now treated of.

The developement of truth is often so gradual, that it is impossible to assign the time when certain principles have been first introduced into science. Thus, the principle of *Virtual Velocities*, as it is termed, which is now recognized as regulating the equilibrium of all machines whatsoever, was perceived to hold in particular cases long before its full extent, or its perfect universality, was understood. Galileo made a great step toward the establishment of this principle when he generalized the pro-

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[1] Though Berkeley reasons very plausibly, and with considerable address, he hurts his cause by the comparison so often introduced between the mysteries of religion and what he accounts the mysteries of the new geometry. From this it is natural to infer, that the author is avenging the cause of religion on the infidel mathematician to whom his treatise is addressed, and an argument that is suspected to have any other object than that at which it is directly aimed, must always lose somewhat of its weight.

The dispute here mentioned did not take place till about the year 1734; so that I have here treated of it by anticipation, being unwilling to resume the subject of controversies which, though perhaps useful at first for the purpose of securing the foundations of science, are long since set to rest, and never likely to be revived.

perty of the lever, and showed, that an equilibrium takes place whenever the sums of the opposite *momenta* are equal, meaning by momentum the product of the force into the velocity of the point at which it is applied. This was carried farther by Wallis, who appears to have been the first writer who, in his *Mechanica*, published in 1669, founded an entire system of statics on the principle of Galileo, or the equality of the opposite momenta. The proposition, however, was first enunciated in its full generality, and with perfect precision,[1] by John Bernoulli, in a letter to Varignon, so late as the year 1717. Varignon inserted this letter at the end of the second edition of his *Projet d'une Nouvelle Mecanique,* which was not published till 1725. The first edition of the same book appeared in 1687, and had the merit of deriving the whole theory of the equilibrium of the mechanical powers, from the single principle of the composition of forces. At first sight, there appear in mechanics two independent principles of equilibrium, that of the lever, or of equal and opposite momenta, and that of the composition of forces. To show that these coincide, and that the one may be deduced from the other, is, therefore, doing a service to science, and this the ingenious author just named accomplished by help of a property of the parallelogram, which he seems to have been the first who demonstrated.

The *Principia Mathematica* of Newton, published also in 1687, marks a great era in the history of human knowledge, and had the merit of effecting an almost entire revolution in mechanics, by giving new powers and a new direction to its researches. In that work the composition of forces was treated independently of the composition of motion, and the equilibrium of the lever was deduced from the former, as well as in the treatise already mentioned. From the equality of action and re-action it was also inferred, that the state of the centre of gravity of any system of bodies, is not changed by the action of those bodies on one another. This is a great proposition in the mechanics of the universe, and is one of the steps by which that science ascends from the earth to the heavens; for it proves that the quantity

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[1] The principle of Virtual Velocities may be thus enunciated: If a system of bodies be in a state of equilibrium, in consequence of the action of any forces whatever, on certain points in the system; then were the equilibrium to be for a moment destroyed, the small space moved over by each of these points will express the virtual velocity of the power applied to it, and if each force be multiplied into its virtual velocity, the sum of all the products where the velocities are in the same direction, will be equal to the sum of all those in which they are in the opposite.

The distinction between actual and virtual velocities was first made by Bernoulli, and is very essential to thinking as well as to speaking with accuracy on the nature of equilibriums.

of motion existing in nature, when estimated in any one given direction, continues always of the same amount.

But the new applications of mechanical reasoning,—the reduction of questions concerning force and motion to questions of pure geometry,—and the mensuration of mechanical action by its nascent effects,—are what constitute the great glory of the *Principia*, considered as a treatise on the theory of motion. A transition was there made from the consideration of forces acting at stated intervals, to that of forces acting continually,—and from forces constant in quantity and direction to those that converge to a point, and vary as any function of the distance from that point; the proportionality of the areas described about the centre of force, to the times of their description; the equality of the velocities generated in descending through the same distance by whatever route; the relation between the squares of the velocities produced or extinguished, and the sum of the accelerating or retarding forces, computed with a reference, not to the time during which, but to the distance over which they have acted. These are a few of the mechanical and dynamical discoveries contained in the same immortal work; a fuller account of which belongs to the history of physical astronomy.

The end of the seventeenth and the beginning of the eighteenth centuries were rendered illustrious, as we have already seen, by the mathematical discoveries of two of the greatest men who have ever enlightened the world. A slight sketch of the improvements which the theory of mechanics owes to Newton has been just given; those which it owes to Leibnitz, though not equally important, nor equally numerous, are far too conspicuous to be passed over in silence. So far as concerns general principles they are reduced to three,—the argument of the sufficient reason,—the law of continuity,—and the measurement of the force of moving bodies by the square of their velocities; which last, being a proposition that is true or false according to the light in which it is viewed, I have supposed it placed in that which is most favourable.

With regard to the first of these,—*the principle of the sufficient reason*,—according to which, nothing exists in any state without a reason determining it to be in that state rather than in any other,—though it be true that this proposition was first distinctly and generally announced by the philosopher just named, yet is it certain that, long before his time, it had been employed by others in laying the foundations of science. Archimedes and Galileo had both made use of it, and perhaps there never was any attempt to place the elementary truths of science on a solid foundation in which this

principle had not been employed. We have an example of its application in the proof usually given, that a body in motion cannot change the direction of its motion, abstraction being made from all other bodies, and from all external action; for it is evident, that no reason exists to determine the change of motion to be in one direction more than another, and we therefore conclude that no such change can possibly take place. Many other instances might be produced where the same principle appears as an axiom of the clearest and most undeniable evidence. Wherever, indeed, we can pronounce with certainty that the conditions which determine two different things, whether magnitudes or events, are in two cases precisely the same, it cannot be doubted that these events or magnitudes are in all respects identical.

However sound this principle may be in itself, the use which Leibnitz sometimes made of it has tended to bring it into discredit. He argued, for example, that of the particles of matter no two can possess exactly the same properties, or can perfectly resemble one another, otherwise the Supreme Being could have no reason for employing one of them in a particular position more than another, so that both must necessarily be rejected. To argue thus, is to suppose that we completely understand the manner in which motives act on the mind of the Divinity,[1] a postulate that seems but ill suited to the limited sphere of the human understanding. But, if Leibnitz has misapplied his own principle and extended its authority too far, this affords no ground for rejecting it when we are studying the ordinary course of nature, and arguing about the subjects of experiment and observation. In fact, therefore, the sciences which aspire to place their foundation on the solid basis of necessary truth, are much indebted to Leibnitz for the introduction of this principle into philosophy.

Another principle of great use in investigating the laws of motion, and of change in general, was brought into view by the same author,—*the law of Continuity*,—according to which, nothing passes from one state to another without passing through all the intermediate states. Leibnitz considers himself as the first who made known this law; but it is fair to remark, that, in as much as motion is concerned, it was distinctly laid down by Galileo,[2] and ascribed by him to Plato. But, though Leibnitz

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[1] The argument of Leibnitz seems evidently inconclusive. For, though there were two similar and equal atoms, yet as they could not co-exist in the same space, they would not, so far as position is concerned, bear the same relation to the particles that surrounded them; there might exist, therefore, considering them as part of the materials to be employed in the construction of the universe, very good reasons for assigning different situations to each.

[2] *Opere di Galileo*, Tom. III. p. 150, and Tom. II. p. 32. Edit. Padova, 1744.

was not the first to discover the law of continuity, he was the first who regarded it as a principle in philosophy, and used it for trying the consistency of theories, or of supposed laws of nature, and the agreement of their parts with one another. It was in this way that he detected the error of Descartes's conclusions concerning the collision of bodies, showing, that though one case of collision must necessarily graduate into another, the conclusions of that philosopher did by no means pass from one to another by such gradual transition. Indeed, for the purpose of such detections, the knowledge of this law is extremely useful; and I believe few have been much occupied in the investigations either of the pure or mixed mathematics, who have not often been glad to try their own conclusions by the test which it furnishes.

Leibnitz considered this principle as known *à priori*, because if any *saltus* were to take place, that is, if any change were to happen without the intervention of time, the thing changed must be in two different conditions at the same individual instant, which is obviously impossible. Whether this reasoning be quite satisfactory or not, the conformity of the law to the facts generally observed, cannot but entitle it to great authority in judging of the explanations and theories of natural phenomena.

It was the usual error, however, of Leibnitz and his followers, to push the metaphysical principles of science into extreme cases, where they lead to conclusions to which it was hardly possible to assent. The Academy of Sciences at Paris having proposed as a prize question, the Investigation of the Laws of the Communication of Motion,[1] John Bernoulli presented an Essay on the subject, very ingenious and profound, in which, however, he denied the existence of hard bodies, because, in the collision of such bodies, a finite change of motion must take place in an instant, an event which, on the principle just explained, he maintained to be impossible. Though the Essay was admired, this conclusion was objected to, and D'Alembert, in his *Eloge* on the author, remarks, that, even in the collision of elastic bodies, it is difficult to conceive how, among the parts which first come into contact, a sudden change, or a change *per saltum*, can be avoided. Indeed, it can only be avoided by supposing that there is no real contact, and that bodies begin to act upon one another when their surfaces, or what seems to be their surfaces, are yet at a distance.

Maclaurin and some others are disposed, on account of the argument of Bernoulli, to reject the law of continuity altogether. This, however, I cannot help thinking, is

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[1] In 1724.

to deprive ourselves of an auxiliary that, under certain restrictions, may be very useful in our researches, and is often so, even to those who profess to reject its assistance. It is admitted that the law of continuity generally leads right, and if it sometimes lead wrong, the true business of philosophy is to define when it may be trusted to as a safe guide, and what, on the other hand, are the circumstances which render its indications uncertain.

The discourse of Bernoulli, just referred to, brought another new conclusion into the field, and began a controversy among the mathematicians of Europe, which lasted for many years. It was a new thing to see geometers contending about the truths of their own science, and opposing one demonstration to another. The spectacle must have given pain to the true philosopher, but may have afforded consolation to many who had looked with envy on the certainty and quiet prevailing in a region from which they found themselves excluded.

Descartes had estimated the force of a moving body by the quantity of its motion, or by the product of its velocity into its mass. The mathematicians and philosophers who followed him did the same, and the product of these quantities was the measure of force universally adopted. No one, indeed, had ever thought of questioning the conformity of this measure to the phenomena of nature, when, in 1686, Leibnitz announced in the *Leipsic Journal*, the *demonstration of a great error committed by Descartes and others, in estimating the force of moving bodies.* In this paper, the author endeavoured to show, that the force of a moving body is not proportional to its velocity simply, but to the square of its velocity, and he supported this new doctrine by very plausible reasoning. A body, he says, projected upward against gravity, with a double velocity, ascends to four times the height; with the triple velocity, to nine times the height, and so on; the height ascended to being always as the square of the velocity. But the height ascended to is the effect, and is the natural measure of the force, therefore the force of a moving body is as the square of its velocity. Such was the first reasoning of Leibnitz on this subject,—simple, and apparently conclusive; nor should it be forgotten that, during the long period to which the dispute was lengthened out, and notwithstanding the various shapes which it assumed, the reasonings on his side were nothing more than this original argument, changed in its form, or rendered more complex by the combination of new circumstances, so as to be more bewildering to the imagination, and more difficult either to apprehend or to refute.[1]

[1] To mere pressure, Leibnitz gave the name of *vis mortua*, and to the force of moving bodies the name

John Bernoulli was at first of a different opinion from his friend and master, but came at length to adopt the same, which, however, appears to have gone no farther till the discourse was submitted to the Academy of Sciences, as has been already mentioned. The mathematical world could not look with indifference on a question which seemed to affect the vitals of mechanical science, and soon separated into two parties, in the arrangement of which, however, the effects of national predilection might easily be discovered. Germany, Holland, and Italy, declared for the *vis viva;* England stood firm for the old doctrine; and France was divided between the two opinions. No controversy, perhaps, was ever carried on by more illustrious disputants; Maclaurin, Stirling, Desaguliers, Jurin, Clarke, Mairan, were all engaged on the one side, and on the opposite were Bernoulli, Herman, Poleni, S'Gravesende, Muschenbroek; and it was not till long after the period to which this part of the Dissertation is confined, that the debate could be said to be brought to a conclusion. That I may not, however, be obliged to break off a subject of which the parts are closely connected together, I shall take the liberty of transgressing the limits which the consideration of time would prescribe, and of now stating, as far as my plan admits of it, all that respects this celebrated controversy.

A singular circumstance may be remarked in the whole of the dispute. The two parties who adopted such different measures of force, when any mechanical problem was proposed concerning the action of bodies, whether at rest or in motion, resolved it in the same manner, and arrived exactly at the same conclusions. It was therefore evident, that, however much their language and words were opposed, their ideas or opinions exactly agreed. In reality, the two parties were not at issue on the question; their positions, though seemingly opposite, were not contrary to one another; and after debating for nearly thirty years, they found out this to be the truth. That the first men in the scientific world should have disputed so long with one another, without discovering that their opposition was only in words, and that this should have happened, not in any of the obscure and tortuous tracts through which the human mind must grope its way in anxiety and doubt, but in one of the clearest and straightest roads, where it used to be guided by the light of demonstration, is one of the most singular facts in the history of human knowledge.

The degree of acrimony and illiberality which were sometimes mixed in this con-

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of *vis viva.* The former he admitted to be proportional to the simple power of the *virtual* velocity, and the second he held to be proportional to the square of the *actual* velocity.

troversy was not very creditable to the disputants, and proved how much more men take an interest in opinions as being their own, than as being simply in themselves either true or false. The dispute, as conducted by S'Gravesende and Clarke, took this turn, especially on the part of the latter, who, in the schools of theology having sharpened both his temper and his wit, accompanied his reasonings with an insolence and irritability peculiarly ill suited to a discussion about matter and motion. His paper on this subject, in the *Philosophical Transactions*,[1] contains many just and acute remarks, accompanied with the most unfair representation of the argument of his antagonists, as if the doctrine of the *vis viva* were a matter of as palpable absurdity as the denial of one of the axioms of geometry.[2] Now, the truth is, that the argument in favour of living forces is not at all liable to this reproach. One of the effects produced by a moving body is proportional to the square of the velocity, while another is proportional to the velocity simply; and, according to which of these ways the force itself is to be measured, may involve the propriety or impropriety of mathematical language, but cannot be charged with absurdity or contradiction. Absurdity, indeed, was a reproach that neither side had any right to cast on the other.

A dissertation of Mairan, on the force of moving bodies, in the *Memoires of the Academy of Sciences* for 1728, is one of those in which the common measure of force is most ably supported. Nevertheless, for a long time after this, the opinions on that subject in France continued still to be divided. In the list of the disputants we should hardly expect to find a lady included, if we did not know that the name of Madame du Chastellet, along with those of Hypatia and Agnesi, was honourably enrolled in the annals of mathematical learning. Her writings on this subject are full of ingenuity, though, from the fluctuation[3] of her opinions, it seems as if she had not yet en-

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[1] Vol. XXXV. (1728), p. 381. Hutton's *Abridgment*, Vol. VII. p. 219.

[2] In all the arguments for the *vis viva*, this learned metaphysician saw nothing but a conspiracy formed against the Newtonian philosophy. "An extraordinary instance," says he, "of the maintenance of the most palpable absurdity we have had in late years of very eminent mathematicians, Leibnitz, Bernoulli, Herman, Gravesende, who, in order to raise a dust of opposition against the Newtonian philosophy, some years back insisted with great eagerness on a principle which subverts all science, and which easily may be made appear, even to an ordinary capacity, to be contrary to the necessary and essential nature of things." This passage may serve as a proof of the spirit which prevailed among the philosophers of that time, making them ascribe such illiberal views to one another, and distorting so entirely both their own reasoning and those of their adversaries. The spirit awakened by the discovery of fluxions had not yet subsided.

[3] Mad. du Chastellet, in a *Dissertation on Fire*, published in 1740, took the side of Mairan, and bestowed great praise on his discourse on the force of moving bodies. Having, however, afterwards become a convert to the philosophy of Leibnitz, she espoused the cause of the *Vis Viva*, and wrote against Mairan. At

tirely exchanged the caprice of fashion for the austerity of science. About the same time Voltaire engaged in the argument, and in a *Memoire,*[1] presented to the Academy of Sciences in 1741, contended that the dispute was entirely about words. His reasoning is on the whole sound, and the suffrage of one who united the character of a wit, a poet, and a philosopher, must be of great importance in a country where the despotism of fashion extends even to philosophical opinion.

The controversy was now drawing to a conclusion,[2] and in effect may be said to have been terminated by the publication of D'Alembert's *Dynamique* in 1743. I am not certain, however, that all the disputants acquiesced in this decision, at least till some years later. Dr Reid, in an essay *On Quantity*, in the *Philosophical Transactions* for 1748, has treated of this controversy, and remarked, that it had been dropt rather than concluded. In this I confess I differ from the learned author. The controversy seemed fairly ended, the arguments exhausted, and the conclusion established, that the propositions maintained by both sides were true, and were not opposed to one another. Though the mathematical sciences cannot boast of never having had any debates, they can say that those that have arisen have always been brought to a satisfactory termination.

The observations with which I am to conclude the present sketch, are not precisely the same with those of the French philosopher, though they rest nearly on the same foundation.

As the effects of moving bodies, or the changes they produce, may vary considerably with accidental circumstances, we must, in order to measure their force, have recourse to effects which are uniform, and not under the influence of variable causes. First, we may measure the force of one moving body by its effect upon another moving body; and here there is no room for dispute, nor any doubt that the forces of such bodies are as the quantities of matter multiplied into the simple power of the velocities, because

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this time too she drew up a compend of the Leibnitian philosophy for the use of her son, which displays ingenuity and acuteness, and is certainly such a present as very few mothers have ever been in a condition to make to their children. Soon afterwards the same lady, having become a Newtonian, returned to her former opinion about the force of moving bodies, and in the end, gave to her countrymen an excellent translation of the *Principia* of Newton, with a commentary on a part of it, far superior to any other that has yet appeared.

[1] *Doutes sur la Mesure des Forces Motrices; Œuvres* de Voltaire, Tom. XXXIX. p. 91. 8vo. edit. 1785.

[2] Two very valuable papers that appeared at this late period of the dispute are found in the *Philosophical Transactions;* one by Desaguliers, in 1733, full of excellent remarks and valuable experiments; another by Jurin, in 1745, containing a very full state of the whole controversy.

the forces of bodies in which these products are equal, are well known, if opposed, to destroy one another. Thus one effect of moving bodies affords a measure of their force, which does not vary as the *square ;* but as the *simple power* of the velocity.

There is also another condition of moving bodies which may be expected to afford a simple and general measure of their force. When a moving body is opposed by pressure, by a *vis mortua*, or a resistance like that of gravity, the quantity of such resistance required to extinguish the motion, and reduce the body to rest, must serve to measure the force of that body. It is a force which, by repeated impulses, has annihilated another, and these impulses, when properly collected into one sum, must evidently be equal to the force which they have extinguished. It happens, however, that there are two ways of computing the amount of these retarding forces, which lead to different results, both of them just, and neither of them to be assumed to the exclusion of the other.

Suppose the body, the force of which is to be measured, to be projected perpendicularly upward with any velocity, then, if we would compute the quantity of the force of gravity which is employed in reducing it to rest, we may either inquire into the retardation which that force produces during a given time, or while the body is moving over a given space. In other words, we may either inquire how long the motion will continue, or how far it will carry the body before it be entirely exhausted. If the length of the time that the uniform resistance must act before it reduce the body to rest be taken for the effect, and consequently for the measure of the force of the body, that force must be proportional to the velocity, for to this the time is confessedly proportional. If, on the other hand, the length of the line which the moving body describes, while subjected to this uniform resistance, be taken for the effect and the measure of the force, the force must be as the square of the velocity, because to that quantity the line in question is known to be proportional. Here, therefore, are two results, or two values of the same thing, the force of a moving body, which are quite different from one another; an inconsistency which evidently arises from this, that the thing denoted by the term *force*, is too vague and indefinite to be capable of measurement, unless some farther condition be annexed. This condition is no other than a specification of the work to be performed, or of the effect to be produced by the action of the moving body. Thus, when to the question concerning the force of the moving body, you add that it is to be employed in putting in motion another body, which is itself free to move, no doubt remains that the force is as the velocity multiplied into the quantity of matter. So also, if the force of the moving body is to be opposed by a resistance like

that of gravity, the length of time that the motion may continue is one of its measurable effects, and that effect is, like the former, proportional to the velocity. There is a third effect to be considered, and one which always occurs in such an experiment as the last,—the height to which the moving body will ascend. This limitation gives to the force a definite character, and it is now measured by the square of the velocity. In fact, therefore, it is not a precise question to ask, What is the measure of the force of a moving body? You must, in addition, say, How is the moving body to be employed, or in which of its different capacities is it that you would measure its effect? In this state of the question there is no ambiguity, nor any answer to be given but one. Hence it was that the mathematicians and philosophers who differed so much about the general question of the force of moving bodies, never differed about the particular applications of that force. It was because the condition necessary for limiting the vagueness and ambiguity of the *data*, in all such cases, was fully supplied.

In the argument, therefore, so strenuously maintained on the force of moving bodies, both sides were partly in the right and both partly in the wrong. Each produced a measure of force which was just in certain circumstances, and thus far had truth on his side: but each argued that his was the only true measure, so that all others ought to be rejected; and here each of them was in error. Hence, also, it is not an accurate account of the controversy to say that it was about words merely; the disputants did indeed misunderstand one another, but their error lay in ascribing generality to propositions that were true only in particular cases, to which indeed the ambiguity and vagueness of the word *force* materially contributed. It does not appear, however, that any good would now accrue from changing the language of dynamics. If, as has been already said, to the question, How are we to measure the force of a moving body? be added the nature of the effect which is to be produced, all ambiguity will be avoided.

It is, I think, only farther necessary to observe, that, when the resistance opposed to the moving body is not uniform but variable, according to any law, it is not simply either the time or the space which is proportional to the velocity or to the square of the velocity, but functions of those quantities. These functions are obtained from the integration of certain fluxionary expressions, in which the measures above described are applied, the resistance being regarded as uniform for an infinitely small portion of the time or of the space.

Many years after the period I am now treating of, the controversy about the *vis*

viva seemed to revive in England, on the occasion of an Essay on *Mechanical Force*, by the late Mr Smeaton, an able engineer, who, to great practical skill, and much experience, added no inconsiderable knowledge of the mathematics.[1]

The reality of the *vis viva*, then, under certain conditions, is to be considered as a matter completely established. Another inquiry concerning the nature of this force, which also gave rise to considerable debate, was, whether, in the communication of motion, and in the various changes through which moving bodies pass, the quantity of the *vis viva* remains always the same? It had been observed, in the collision of elastic bodies, that the *vis viva*, or the sum made up by multiplying each body into the square of its velocity, and adding the products together, was the same after collision that it was before it, and it was concluded with some precipitation, by those who espoused the Leibnitian theory, that a similar result always took place in the real phenomena of nature. Other instances were cited; and it was observed, that a particular view of this principle which presented itself to Huygens, had enabled him to find the centre of oscillation of a compound pendulum, at a time when the state of mechanical science was scarcely prepared for so difficult an investigation. The proposition, however, is true only when all the changes are gradual, and rigorously subjected to the law of continuity. Thus, in the collision of bodies imperfectly elastic (a case which continually occurs in nature), the force which, during the recoil, accelerates the separation of the bodies, does not restore to them the whole velocity they had lost, and the *vis viva*, after the collision, is always less than it was before it. The cases in which the whole amount of the *vis viva* is rigorously preserved, may always be brought under the thirty-ninth proposition of the first book of the *Principia*, where the principle of this theory is placed on its true foundation.

So far as General Principles are concerned, the preceding are the chief mechanical improvements which belong to the period so honourably distinguished by the names of Newton and Leibnitz. The application of these principles to the solution of particular problems would afford materials for more ample discussion than suits the nature of a historical outline. Such problems as that of finding the centre of oscillation,—the nature of the catenarian curve,—the determination of the line of swiftest descent,—the retardation produced to motion in a medium that resists according to the square of the velocity, or indeed according to any function of it,—the determination of the elastic

[1] Note E, at the end.

curve, or that into which an elastic spring forms itself when a force is applied to bend it,—all these were problems of the greatest interest, and were now resolved for the first time; the science of mechanics being sufficient, by means of the composition of forces, to find out the fluxionary or differential equations which expressed the nature of the gradual changes which in all these cases were produced, and the calculus being now sufficiently powerful to infer the properties of the finite from those of the infinitesimal quantities.

The doctrine of Hydrostatics was cultivated in England by Cotes. The properties of the atmosphere, or of elastic fluids, were also experimentally investigated; and the barometer, after the ingenuity of Pascal had proved that the mercury stood lower the higher up into the atmosphere the instrument was carried, was at length brought to be a measure of the height of mountains. Mariotte appears to have been the first who proposed this use of it, and who discovered that, while the height from the ground increases in arithmetical, the density of the atmosphere, and the column of mercury in the barometer, decrease in geometrical progression. Halley, who seems also to have come of himself to the same conclusion, proved its truth by strict geometrical reasoning, and showed, that logarithms are easily applicable on this principle to the problem of finding the height of mountains. This was in the year 1685. Newton two years afterwards gave a demonstration of the same, extended to the case when gravity is not constant, but varies as any power of the distance from a given centre.

To the assiduous observations and the indefatigable activity of Halley, the natural history of the atmosphere, of the ocean, and of magnetism, are all under the greatest obligations. For the purpose of inquiring into these objects, this ardent and philosophical observer relinquished the quiet of academical retirement, and, having gone to St Helena, by a residence of a year in that island, not only made an addition to the catalogue of the stars, of 360 from the southern hemisphere, but returned with great acquisitions both of nautical and meteorological knowledge. His observations on evaporation were the foundation of two valuable papers on the origin of fountains; in which, for the first time, the sufficiency of the vapour taken up into the atmosphere, to maintain the perennial flow of springs and rivers, was established by undeniable evidence. The difficulty which men found in conceiving how a precarious and accidental supply like that of the rains, can sufficiently provide for a great and regular expenditure like that of the rivers, had given rise to those various opinions concerning the origin of fountains, which had hitherto divided the scientific world. A long re-

sidence on the summit of an insulated rock, in the midst of a vast ocean, visited twice every year by the vertical sun, would have afforded to an observer, less quick-sighted than Halley, an opportunity of seeing the work of evaporation carried on with such rapidity and copiousness as to be a subject of exact measurement. From this extreme case, he could infer the medium quantity, at least by approximation; and he proved that, in the Mediterranean, the humidity daily raised up by evaporation is three times as great as that which is discharged by all the rivers that flow into it. The origin of fountains was no longer questioned, and of the multitude of opinions on that subject, which had hitherto perplexed philosophers, all but one entirely disappeared.[1]

Beside the voyage to St Helena, Halley made two others; the British government having been enlightened, and liberal enough to despise professional *etiquette*, where the interests of science were at stake, and to entrust to a Doctor of Laws the command of a ship of war, in which he traversed the Atlantic and Pacific Oceans in various directions, as far as the 53d degree of south latitude, and returned with a collection of facts and observations for the improvement of geography, meteorology, and navigation, far beyond that which any individual traveller or voyager had hitherto brought together.

The variation of the compass was long before this time known to exist, but its laws had never yet been ascertained. These Halley now determined from his own observations, combined with those of former navigators, in so far as to trace, on a nautical chart, the lines of the same variation over a great part both of the Atlantic and Pacific Oceans, affording to the navigator the ready means of correcting the errors which the deviation of the needle from the true meridian was calculated to produce. In his different traverses he had four times intersected the line of no variation, which seemed to divide the earth into two parts, the variations on the east side being towards the west, and on the west side towards the east. These lines being found to change their position in the course of time, the place assigned to the magnetical poles could not be permanent. Any theory, therefore, which could afford an explanation of their changes must necessarily be complex and difficult to be established. The attempt of Halley to give such an explanation, though extremely ingenious, was liable to great objections; and while it has shared the fate of most of the theories which have been laid

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[1] *Philosophical Transactions*, 1687, Vol. XVI. p. 366.

down before the phenomena had been sufficiently explored, the general facts which he established have led to most of the improvements and discoveries which have since been made respecting the polarity of the needle.

Besides the conclusion just mentioned, Dr Halley derived, from his observations, a very complete history of the winds which blow in the tropical regions, viz. the trade-wind, and the monsoons, together with many interesting facts concerning the phenomena of the tides. The chart which contained an epitome of all these facts was published in 1701.

The above are only a part of the obligations which the sciences are under to the observations and reasonings of this ingenious and indefatigable inquirer. Halley was indeed one of the ablest and most accomplished men of his age. A scholar well versed in the learned languages, and a geometer profoundly skilled in the ancient analysis, he restored to their original elegance some of the precious fragments of that analysis, which time happily had not entirely defaced. He was well acquainted also with the algebraical and fluxionary calculus, and was both in theory and practice a profound and laborious astronomer. Finally, he was the friend of Newton, and often stimulated, with good effect, the tardy purposes of that great philosopher. Few men, therefore, of any period, have more claims than Halley on the gratitude of succeeding ages.

The invention of the thermometer has been already noticed, and the improvements made on that instrument about this period, laid the foundation of many future discoveries. The discovery of two fixed temperatures, each marked by the same expansion of the mercury in the thermometer, and the same condition of the fluid in which it is immersed, was made about this time. The differences of temperature were thus subjected to exact measurement; the phenomena of heat became, of course, known with more certainty and precision; and that substance or virtue, to which nothing is impenetrable, and which finds its way through the rarest and the densest bodies, apparently with the same facility,—which determines so many of our sensations, and of which the distribution so materially influences all the phenomena of animal and vegetable life, came now to be known, not indeed in its essence, but as to all the characters in which we are practically or experimentally concerned. The treatise on Fire, in Boerhaave's *Chemistry*, is a great advance beyond any thing on that subject hitherto known, and touches, notwithstanding many errors and imperfections, on most of the great truths, which time, experience, and ingenuity, have since brought into view.

It was in this period also, that electricity may be said first to have taken a scientific form. The power of amber to attract small bodies, after it has been rubbed, is said to have been known to Thales, and is certainly made mention of by Theophrastus. The observations of Gilbert, a physician of Colchester, in the end of the sixteenth century, though at the distance of two thousand years, made the first addition to the transient and superficial remarks of the Greek naturalist, and afford a pretty full enumeration of the bodies which can be rendered electrical by friction. The Academia del Cimento, Boyle, and Otto Guericke, followed in the same course; and the latter is the first who mentions the crackling noise and faint light which electricity sometimes produced. These, however, were hardly perceived, and it was by Dr Wall, as described in the *Philosophical Transactions*, that they were first distinctly observed.[1] By a singularly fortunate anticipation, he remarks of the light and crackling, that they seemed in some degree to represent thunder and lightning.

After the experiments of Hauksbee in 1709, by which the knowledge of this mysterious substance was considerably advanced, Wheeler and Gray, who had discovered that one body could communicate electricity to another without rubbing, being willing to try to what distance the electrical virtue might be thus conveyed, employed, for the purpose of forming the communication, a hempen rope, which they extended to a considerable length, supporting it from the sides, by threads which, in order to prevent the dissipation of the electricity, they thought it proper to make as slender as possible. They employed silk threads with that view, and found the experiment to succeed. Thinking that it would succeed still better, if the supports were made still more slender, they tried very fine metallic wire, and were surprised to find, that the hempen rope, thus supported, conveyed no electricity at all. It was, therefore, as being *silk*, and not as being *small*, that the threads had served to retain the electricity. This accident led to the great distinction of substances conducting, and not conducting electricity. An extensive field of inquiry was thus opened, a fortunate accident having supplied an *instantia crucis*, and enabled these experimenters to distinguish between what was essential and what was casual in the operation they had performed. The history of electricity, especially in its early stages, abounds with facts

[1] Wall's paper is in the *Transactions* for 1708, Vol. XXVI. No. 314, p. 69.—Hauksbee on *Electrical Light*, in the same volume. See *Abridgment*, Vol. V. p. 408, 411.

of this kind; and no man, who would study the nature of inductive science, and the rules for the interpretation of nature, can employ himself better than in tracing the progress of these discoveries. He will find abundant reason to admire the ingenuity as well as the industry of the inquirers, but he will often find accident come in very opportunely to the assistance of both. The experiments of Wheeler and Gray are described in the *Transactions* for 1729.

Section III.

OPTICS.

The invention of the telescope and the microscope, the discoveries made concerning the properties of light and the laws of vision, added to the facility of applying mathematical reasoning as an instrument of investigation, had long given a peculiar interest to optical researches. The experiments and inquiries of Newton on that subject began in 1666, and soon made a vast addition both to the extent and importance of the science. He was at that time little more than twenty-three years old; he had already made some of the greatest and most original discoveries in the pure mathematics; and the same young man, whom we have been admiring as the most profound and inventive of geometers, is to appear, almost at the same moment, as the most patient, faithful, and sagacious interpreter of nature. These characters, though certainly not opposed to one another, are not often combined; but to be combined in so high a degree, and in such early life, was hitherto without example.

In hopes of improving the telescope, by giving to the glasses a figure different from the spherical, he had begun to make experiments, and had procured a glass prism, in order, as he tells us, to try with it the *celebrated phenomena of colours.*[1] These trials led to the discovery of the different refrangibility of the rays of light, and are now too well known to stand in need of a particular description.

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[1] *Phil. Trans.* Vol. VI. (1672), p. 3075. Also Hutton's *Abridgment*, Vol. I. p. 678. The account of the experiments is in a letter to Oldenburgh, dated February 1672; it is the first of Newton's works that was published. It is plain from what is said above, that the phenomena of the prismatic spectrum were not unknown at that time, however little they were understood, and however imperfectly observed.

Having admitted a beam of light into a dark chamber, through a hole in the window-shutter, and made it fall on a glass prism, so placed as to cast it on the opposite wall, he was delighted to observe the brilliant colouring of the sun's image, and not less surprised to observe its figure, which, instead of being circular, as he expected, was oblong in the direction perpendicular to the edges of the prism, so as to have the shape of a parallelogram, rounded at the two ends, and nearly five times as long as it was broad.

When he reflected on these appearances, he saw nothing that could explain the elongation of the image but the supposition that some of the rays of light, in passing through the prism, were more refracted than others, so that rays which were parallel when they fell on the prism, diverged from one another after refraction, the rays that differed in refrangibility differing also in colour. The *spectrum*, or solar image, would thus consist of a series of circular images partly covering one another, and partly projecting one beyond another, from the red or least refrangible rays, in succession, to the orange, yellow, green, blue, indigo, and violet, the most refrangible of all.

It was not, however, till he tried every other hypothesis which suggested itself to his mind by the test of experiment, and proved its fallacy, that he adopted this as a true interpretation of the phenomena. Even after these rejections, his explanation had still to abide the sentence of an *experimentum crucis.*

Having admitted the light and applied a prism as before, he received the coloured spectrum on a board at the distance of about twelve feet from the first, and also pierced with a small hole. The coloured light which passed through this second hole was made to fall on a prism, and afterwards received on the opposite wall. It was then found that the rays which had been most refracted, or most bent from their course by the first prism, were most refracted also by the second, though no new colours were produced. "So," says he, "the true cause of the length of the image was detected to be no other than that light consists of rays differently refrangible, which, without any respect to a difference in their incidence, were, according to their degrees of refrangibility, transmitted towards divers parts of the wall."[1]

It was also observed, that when the rays which fell on the second prism were all of the same colour, the image formed by refraction was truly circular, and of the same

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[1] *Phil. Trans.* Vol VI. (1672), No. 80. p. 3075.

colour with the incident light. This is one of the most conclusive and satisfactory of all the experiments.

When the sun's light is thus admitted first through one aperture, and then through another at some distance from the first, and is afterwards made to fall on a prism, as the rays come only from a part of the sun's disk, the spectrum has nearly the same length as before, but the breadth is greatly diminished; in consequence of which, the light at each point is purer, it is free from penumbra, and the confines of the different colours can be more accurately traced. It was in this way that Newton measured the extent of each colour, and taking the mean of a great number of measures, he assigned the following proportions, dividing the whole length of the spectrum, exclusive of its rounded terminations, into 360 equal parts; of these the

Red occupied - -	45
Orange - -	27
Yellow - -	48
Green - -	60
Blue - -	60
Indigo - -	40
Violet - -	80.

Between the divisions of the spectrum, thus made by the different colours, and the divisions of the monochord by the notes of music, Newton conceived that there was an analogy, and indeed an identity of ratios; but experience has since shown that this analogy was accidental, as the spaces occupied by the different colours do not divide the spectrum in the same ratio, when prisms of different kinds of glass are employed.

Such were the experiments by which Newton first " untwisted all the shining robe of day," and made known the texture of the magic garment which nature has so kindly spread over the surface of the visible world. From them it followed, that colours are not qualities which light derives from refraction or reflection, but are original and *connate* properties connected with the different degrees of refrangibility that belong to the different rays. The same colour is always joined to the same degree of refrangibility, and conversely, the same degree of refrangibility to the same colour.

Though the seven already enumerated are primary and simple colours, any of them may also be produced by a mixture of others. A mixture of yellow and blue,

for instance, makes green; of red and yellow orange; and, in general, if two colours, which are not very far asunder in the natural series, be mixed together, they compound the colour that is in the middle between them.

But the most surprising composition of all, Newton observes, is that of whiteness; which is not produced by one sort of rays, but by the mixture of all the colours in a certain proportion, namely, in that proportion which they have in the solar spectrum. This fact may be said to be made out both by analysis and composition. The white light of the sun can be separated, as we have just seen, into the seven simple colours; and if these colours be united again they form white. Should any of them have been wanting, or not in its due proportion, the white produced is defective.

It appeared, too, that natural bodies, of whatever colour, if viewed by simple and homogeneous light, are seen of the colour of that light and of no other. Newton tried this very satisfactory experiment on bodies of all colours, and found it to hold uniformly; the light was never changed by the colour of the body that reflected it.

Newton, thus furnished with so many new and accurate notions concerning the nature and production of colour, proceeded to apply them to the explanation of phenomena. The subject which naturally offered itself the first to this analysis was the rainbow, which, by the grandeur and simplicity of its figure, added to the brilliancy of its colours, in every age has equally attracted the attention of the peasant and of the philosopher. That two refractions and one reflection were at least a part of the machinery which nature employed in the construction of this splendid arch, had been known from the time of Antonio de Dominis;[1] and the manner in which the arched figure is produced had been shown by Descartes; so that it only remained to explain the nature of the colour and its distribution. As the colours were the same with those exhibited by the prism, and succeeded in the same order, it could hardly be doubted that the cause was the same. Newton showed the truth of his principles by calculating the extent of the arch, the breadth of the coloured bow, the position of the secondary bow, its distance from the primary, and by explaining the inversion of the colours.[2] There is not, perhaps, in science any happier application of theory, or any in which the mind rests with fuller confidence.

Other meteoric appearances seemed to be capable of similar explanations, but the phenomena being no where so regular or so readily subjected to measurement as those

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[1] Note F, at the end.

[2] *Optics*, Book I. prop. 9.

of the rainbow, the theory cannot be brought to so severe a test, nor the evidence rendered so satisfactory.

But a more difficult task remained,—to explain the permanent colour of natural bodies. Here, however, as it cannot be doubted that all colour comes from the rays of light, so we must conclude that one body is red and another violet, because the one is disposed to reflect the red or least refrangible rays, and the other to reflect the violet or the most refrangible. Every body manifests its disposition to reflect the light of its own peculiar colour, by this, that if you cast on it pure light, first of its own colour, and then of any other, it will reflect the first much more copiously than the second. If cinnabar, for example, and ultra-marine blue be both exposed to the same red homogeneous light, they will both appear red; but the cinnabar strongly luminous and resplendent, and the ultra-marine of a faint obscure red. If the homogeneal light thrown on them be blue, the converse of the above will take place.

Transparent bodies, particularly fluids, often transmit light of one colour and reflect light of another. Halley told Newton, that, being deep under the surface of the sea in a diving-bell, in a clear sunshine day, the upper side of his hand, on which the sun shone darkly through the water, and through a small glass window in the diving-bell, appeared of a red colour, like a damask rose, while the water below, and the under part of his hand, looked green.[1]

But, in explaining the permanent colour of bodies, this difficulty always presents itself,—Suppose that a body reflects red or green light, what is it that decomposes the light, and separates the red or the green from the rest? Refraction is the only means of decomposing light, and separating the rays of one degree of refrangibility and of one colour, from those of another. This appears to have been what led Newton to study the colours produced by light passing through thin plates of any transparent substance. The appearances are very remarkable, and had already attracted the attention, both of Boyle and of Hook, but the facts observed by them remained insulated in their hands, and unconnected with other optical phenomena.

It probably had been often remarked, that when two transparent bodies, such as glass, of which the surfaces were convex in a certain degree, were pressed together, a black spot was formed at the contact of the two, which was surrounded with coloured rings, more or less regular, according to the form of the surfaces. In order to ana-

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[1] *Optics*, p. 115. Horseley's edit.

lyse a phenomenon that seemed in itself not a little curious, Newton proposed to make the experiment with surfaces of a regular curvature, such as was capable of being measured. He took two object glasses, one a plano-convex for a fourteen feet telescope, the other a double convex for one of about fifty feet, and upon this last he laid the other with its plane side downwards, pressing them gently together. At their contact in the centre was a pellucid spot, through which the light passed without suffering any reflection. Round this spot was a coloured circle or ring, exhibiting blue, white, yellow, and red. This was succeeded by a pellucid or dark ring, then a coloured ring of violet, blue, green, yellow, and red, all copious and vivid except the green. The third coloured ring consisted of purple, blue, green, yellow, and red. The fourth consisted of green and red; those that succeeded became gradually more dilute and ended in whiteness. It was possible to count as far as seven.

The colours of these rings were so marked by peculiarities in shade and vivacity, that Newton considered them as belonging to different orders; so that an eye accustomed to examine them, on any particular colour of a natural object being pointed out, would be able to determine to what order in this series it belonged.

Thus we have a system of rings or zones surrounding a dark central spot, and themselves alternately dark and coloured, that is, alternately transmitting the light and reflecting it. It is evident that the thickness of the plates of air interposed between the glasses, at each of those rings, must be a very material element in the arrangement of this system. Newton, therefore, undertook to compute their thickness. Having carefully measured the diameters of the first six coloured rings, at the most lucid part of each, he found their squares to be as the progression of odd numbers 1, 3, 5, 7, &c. The squares of the distances from the centre of the dark spot to each of these circumferences, were, therefore, in the same ratio, and consequently the thickness of the plates of air, or the intervals between the glasses, were as the numbers 1, 3, 5, 7, &c.

When the diameters of the dark or pellucid rings which separated the coloured rings were measured, their squares were found to be as the even numbers 0, 2, 4, 6, and, therefore, the thickness of the plates through which the light was wholly transmitted were as the same numbers. A great many repeated measurements assured the accuracy of these determinations.

As the curvature of the convex glass on which the flat surface of the plano-convex rested was known, and as the diameters of the rings were measured in inches, it was easy to compute the thickness of the plates of air, which corresponded to the different rings.

An inch being divided into 178000 parts, the distance of the lenses for the first series, or for the luminous rings, was $\frac{1}{178000}$, $\frac{3}{178000}$, $\frac{5}{178000}$, &c.

For the second series $\frac{2}{178000}$, $\frac{4}{178000}$, &c.

When the rings were examined by looking through the lenses in the opposite direction, the central spot appeared white, and, in other rings, red was opposite to blue, yellow to violet, and green to a compound of red and violet; the colours formed by the transmitted and the reflected light being, what is now called, complementary, or nearly so, of one another; that is, such as when mixed produce white.

When the fluid between the glasses was different from air, as when it was water, the succession of rings was the same ; the only difference was, that the rings themselves were narrower.

When experiments on thin plates were made in such a way that the plate was of a denser body than the surrounding medium, as in the case of soap-bubbles, the same phenomena were observed to take place. These phenomena Newton also examined with his accustomed accuracy, and even bestowed particular care on having the soap-bubbles as perfect and durable as their frail structure would admit. In the eye of philosophy no toy is despicable, and no occupation frivolous, that can assist in the discovery of truth.

To the different degrees of tenuity, then, in transparent substances, there seemed to be attached the powers of separating particular colours from the mass of light, and of rendering them visible sometimes by reflection, and, in other cases, by transmission. As there is reason to think, then, that the minute parts, the mere particles of all bodies, even the most opaque, are transparent, they may very well be conceived to act on light after the manner of the thin plates, and to produce each, according to its thickness and density, its appropriate colour, which, therefore, becomes the colour of the surface. Thus the colours in which the bodies round us appear everywhere arrayed, are reducible to the action of the parts which constitute their surfaces on the refined and active fluid which pervades, adorns, and enlightens the world.

But the same experiments led to some new and unexpected conclusions, that seemed to reach the very essence of the fluid of which we now speak. It was impossible to observe, without wonder, the rings alternately luminous and dark that were formed between the two plates of glass in the preceding experiments, and determined to be what they were by the different thickness of the air between the plates, and having to

that thickness the relations formerly expressed. A plate of which the thickness was equal to a certain quantity multiplied by an odd number, gave always a circle of the one kind; but if the thickness of the plate was equal to the same quantity multiplied by an even number, the circle was of another kind, the light, in the first case, being reflected, in the second transmitted. Light penetrating a thin transparent plate, of which the thickness was m, $3m$, $5m$, &c. was decomposed and reflected; the same light penetrating the same plate, but of the thickness 0, $2m$, $4m$, was transmitted, though, in a certain degree, also decomposed. The same light, therefore, was transmitted or reflected, according as the second surface of the plate of air through which it passed was distant from the first by the intervals 0, 2, $4m$, or m, $3m$, $5m$; so that it becomes necessary to suppose the same ray to be successively disposed to be transmitted and to be reflected at points of space separated from one another by the same interval m. This constitutes what Newton called ***Fits of easy transmission and easy reflection***, and forms one of the most singular parts of his optical discoveries. It is so unlike any thing which analogy teaches us to expect, that it has often been viewed with a degree of incredulity, and regarded as at best but a conjecture introduced to account for certain optical phenomena. This, however, is by no means a just conclusion, for it is, in reality, a necessary inference from appearances accurately observed, and is no less entitled to be considered as a fact than those appearances themselves. The difficulty of assigning a cause for such extraordinary alternations cannot be denied, but does not entitle us to doubt the truth of a conclusion fairly deduced from experiment. The principle has been confirmed by phenomena that were unknown to Newton himself, and possesses this great and unequivocal character of philosophic truth, that it has served to explain appearances which were not observed till long after the time when it first became known.

We cannot follow the researches of Newton into what regards the colours of thick plates, and of bodies in general. We must not, however, pass over his explanation of refraction, which is among the happiest to be met with in any part of science, and has the merit of connecting the principles of optics with those of dynamics.

The theory from which the explanation we speak of is deduced is, that light is an emanation of particles, moving in straight lines with incredible velocity, and attracted by the particles of transparent bodies. When, therefore, light falls obliquely on the surface of such a body, its motion may be resolved into two, one parallel to that surface, and the other perpendicular to it. Of these, the first is not affected

by the attraction of the body, which is perpendicular to its own surface; and, therefore, it remains the same in the refracted that it was in the incident ray. But the velocity perpendicular to the surface is increased by the attraction of the body, and, according to the principles of dynamics (the 39th, Book I. *Princip.*), whatever be the quantity of this velocity, its square, on entering the same transparent body, will always be augmented by the same quantity. But it is easy to demonstrate that, if there be two right-angled triangles, with a side in the one equal to a side in the other, the hypothenuse of the first being given, and the squares of their remaining sides differing by a given space, the sines of the angles opposite to the equal sides must have a given ratio to one another.[1] This amounts to the same with saying, that, in the case before us, the sine of the angle of incidence is to the sine of the angle of refraction in a given ratio. The explanation of the law of refraction thus given is so highly satisfactory, that it affords a strong argument in favour of the system which considers light as an emanation of particles from luminous bodies, rather than the vibrations of an elastic fluid. It is true that Huygens deduced from this last hypothesis an explanation of the law of refraction, on which considerable praise was bestowed in the former part of this Dissertation. It is undoubtedly very ingenious, but does not rest on the same solid and undoubted principles of dynamics with the preceding, nor does it leave the mind so completely satisfied. Newton, in his *Principia*, has deduced another demonstration of the same optical proposition from the theory of central forces.[2]

The different refrangibility of the rays of light forms no exception to the reasoning above. The rays of each particular colour have their own particular ratio subsisting between the sines of incidence and refraction, or in each, the square that is added to the square of the perpendicular velocity has its own value, which continues the same while the transparent medium is the same.

Light, in consequence of these views, became, in the hands of Newton, the means of making important discoveries concerning the internal and chemical constitution of bodies. The square that is added to that of the perpendicular velocity of light in consequence of the attractive force of the transparent substance, is properly the measure of the quantity of that attraction, and is the same with the difference of the squares of the velocities of the incident and the refracted light. This is readily deduced,

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[1] *Optics*, Book II. Part iii. prop. 10.

[2] *Prin. Math.* Lib. I. prop. 94. Also *Optics*, Book I. prop. 6.

therefore, from the ratio of the angle of incidence to that of refraction ; and when this is done for different substances, it is found, that the above measure of the refracting power of transparent bodies is nearly proportional to their density, with the exception of those which contain much inflammable matter in their composition, or sulphur as it was then called, which is always accompanied with an increase of refracting power.[1]

Thus, the refracting power, ascertained as above, when divided by the density, gives quotients not very different from one another, till we come to the inflammable bodies, where a great increase immediately takes place. In air, for instance, the quotient is 5208, in rock-crystal 5450, and the same nearly in common glass. But in spirit of wine, oil, amber, the same quotients are 10121, 12607, 13654. Newton found in the diamond, that this quotient is still greater than any of the preceding, being 14556.[2] Hence he conjectured, what has since been so fully verified by experiment, that the diamond, at least in part, is an inflammable body. Observing, also, that the refracting power of water is great for its density, the quotient, expounding it, as above, being 7845, he concluded, that an inflammable substance enters into the composition of that fluid,—a conclusion which has been confirmed by one of the most certain but most unexpected results of chemical analysis. The views thus suggested by Newton have been successfully pursued by future inquirers, and the action of bodies on light is now regarded as one of the means of examining into their internal constitution.

I should have before remarked, that the alternate disposition to be easily reflected and easily transmitted, serves to explain the fact, that all transparent substances reflect a portion of the incident light. The reflection of light from the surfaces of opaque bodies, and from the anterior surfaces of transparent bodies, appears to be produced by a repulsive force exerted by those surfaces at a determinate but very small distance, in consequence of which there is stretched out over them an elastic web through which the particles of light, notwithstanding their incredible velocity, are not always able to penetrate.[3] In the case of a transparent body, the light which, when it arrives at this outwork, as it may be called, is in a *fit* of easy reflection, obeys of course the repulsive force, and is reflected back again. The particles, on the other hand, which

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[1] Newton's *Optics*, Ibid. [2] Ibid.

[3] A velocity that enables light to pass from the sun to the earth in 8′ 13″, as is deduced from the eclipses of Jupiter's satellites.

are in the state which disposes them to be transmitted, overcome the repulsive force, and, entering into the interior of the transparent body, are subjected to the action of its attractive force, and obey the law of refraction already explained. If these rays, however, reach the second surface of the transparent body (that body being supposed denser than the medium surrounding it), in a direction having a certain obliquity to that surface, the attraction will not suffer the rays to emerge into the rarer medium, but will force them to return back into the transparent body. Thus the reflection of light at the second surface of a transparent body is produced, not by the repulsion of the medium in which it was about to enter, but by the attraction of that which it was preparing to leave.

The first account of the experiments from which all these conclusions were deduced, was given in the *Philosophical Transactions* for 1672, and the admiration excited by their brilliancy and their novelty may easily be imagined. Among the men of science, the most enlightened were the most enthusiastic in their praise. Huygens, writing to one of his friends, says of them, and of the truths they were the means of making known, "*Quorum respectu omnia huc usque edita jejunia sunt et prorsus puerilia.*" Such were the sentiments of the person who, of all men living, was the best able to judge, and had the best right to be fastidious in what related to optical experiments and discoveries. But all were not equally candid with the Dutch philosopher; and though the discovery now communicated had every thing to recommend it which can arise from what is great, new and singular; though it was not a theory or a system of opinions, but the generalization of facts made known by experiments; and though it was brought forward in the most simple and unpretending form, a host of enemies appeared, each eager to obtainthe unfortunate pre-eminence of being the first to attack conclusions which the unanimous voice of posterity was to confirm. In this contention, the envy and activity of Hook did not fail to give him the advantage, and he communicated his objections to Newton's conclusions concerning the refrangibility of light in less than a month after they had been read in the Royal Society. He admitted the accuracy of the experiments themselves, but denied that the cause of the colour is any quality residing permanently in the rays of light, any more than that the sounds emitted from the pipes of an organ exist originally in the air. An imaginary analogy between sound and light seems to have been the basis of all his optical theories. He conceived that colour is nothing but the disturbance of light by pulses propagated through it; that blackness proceeds from the scarcity, whiteness from the plenty, of undisturbed light; and that

the prism acts by exciting different pulses in this fluid, which pulses give rise to the sensations of colour. This obscure and unintelligible theory (if we may honour what is unintelligible with the name of a theory) he accompanied with a multitude of captious objections to the reasonings of Newton, whom he was not ashamed to charge with borrowing from him without acknowledgment. To all this Newton replied, with the solidity, calmness, and modesty, which became the understanding and the temper of a true philosopher.

The new theory of colours was quickly assailed by several other writers, who seem all to have had a better apology than Hooke for the errors into which they fell. Among them one of the first was Father Pardies, who wrote against the experiments, and what he was pleased to call the hypothesis, of Newton. A satisfactory and calm reply convinced him of his mistake, which he had the candour very readily to acknowledge. A countryman of his, Mariotte, was more difficult to be reconciled, and, though very conversant with experiment, appears never to have succeeded in repeating the experiments of Newton. Desaguliers, at the request of the latter, repeated the experiments doubted of before the Royal Society, where Monmort, a countryman and a friend of Mariotte, was present. [1]

MM. Linus and Lucas, both of Leige, objected to Newton's experiments as inaccurate; the first, because, on attempting to repeat them, he had not obtained the same results; and the second, because he had not been able to perceive that a red object and a blue required the focal distance to be different when they were viewed through a telescope. Newton replied with great patience and good temper to both.

The series was closed, in 1727, by the work of an Italian author, Rizetti, who, in like manner, called in question the accuracy of experiments which he himself had not been able to repeat. Newton was now no more, but Desaguliers, in consequence of Rizetti's doubts, instituted a series of experiments which seemed to set the matter entirely at rest. These experiments are described in the *Philosophical Transactions* for 1728.

An inference which Newton had immediately drawn from the discoveries above described was, that the great source of imperfection in the refracting telescope was the different refrangibility of the rays of light, and that there were stronger reasons than

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[1] Montucla, Tom. II.

either Mersenne or Gregory had suspected, for looking to reflection for the improvement of optical instruments. It was evident, from the different refrangibility of light, that the rays coming from the same point of an object, when decomposed by the refraction of a lens, must converge to different foci; the red rays, for example, to a point more distant from the lens, and the violet to one nearer by about a fifty-fourth part of the focal distance. Hence it was not merely from the aberration of the rays caused by the spherical figure of the lens that the imperfection of the images formed by refraction arose, but from the very nature of refraction itself. It was evident, at the same time, that in a combination of lenses with opposite figures, one convex, for instance, and another concave, there was a tendency of the two contrary dispersions to correct one another. But it appeared to Newton, on examining different refracting substances, that the dispersion of the coloured rays never could be corrected except when the refraction itself was entirely destroyed, for he thought he had discovered that the quantity of the refraction and of the dispersion in different substances bore always the same proportion to one another. This is one of the few instances in which his conclusions have not been confirmed by subsequent experiment; and it will, accordingly, fall under discussion in another part of this discourse.

Having taken the resolution of constructing a reflecting telescope, he set about doing so with his own hands. There was, indeed, at that time, no other means by which such a work could be accomplished; the art of the ordinary glass-grinder not being sufficient to give to metallic specula the polish which was required. It was on this account that Gregory had entirely failed in realizing his very ingenious optical invention.

Newton, however, himself possessed excellent hands for mechanical operations, and could use them to better purpose than is common with men so much immersed in deep and abstract speculation. It appears, indeed, that mechanical invention was one of the powers of his mind which began to unfold itself at a very early period. In some letters subjoined to a Memoir drawn up after his death by his nephew Conduit, it is said, that, when a boy, Newton used to amuse himself with constructing machines, mills, &c. on a small scale, in which he displayed great ingenuity; and it is probable that he then acquired that use of his hands which is so difficult to be learned at a later period. To this, probably, we owe the neatness and ingenuity with which the optical experiments above referred to were contrived and executed,—experiments of so difficult a nature, that any error in the manipulation would easily defeat the effect, and

appears actually to have done so with many of those who objected to his experiments. [1]

He succeeded perfectly in the construction of his telescope, and his first communication with Oldenburg, and the first reference to his optical experiments, is connected with the construction of this instrument, and mentioned in a letter dated the 11th January 1672. He had then been proposed as a member of the Royal Society by the Bishop of Sarum, and he says, " If the honour of being a member of the Society shall be conferred on me, I shall endeavour to testify my gratitude by communicating what my poor and solitary endeavours can effect toward the promoting its philosophical designs." [2] Such was the modesty of the man who was to effect a greater revolution in the state of our knowledge of nature than any individual had yet done, and greater, perhaps, than any individual is ever destined to bring about. Success, however, never altered the temper in which he began his researches.

Newton, after considering the reflection and refraction of light, proceeded, in the third and last Book of his *Optics*, to treat of its *inflexion*, a subject which, as has been remarked in the former part of this discourse, was first treated of by Grimaldi. Newton having admitted a ray of light through a hole in a window-shutter into a dark chamber, made it pass by the edge of a knife, or, in some experiments, between the edges of two knives, fixed parallel, and very near to one another; and, by receiving the light on a sheet of paper at different distances behind the knives, he observed the coloured fringes which had been described by the Italian optician, and,

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[1] The *Memoir* of Conduit was sent to Fontenelle when he was preparing the *Eloge* on Newton, but he seems to have paid little attention to it, and has passed over the early part of his life with the remark, that one may apply to him what Lucan says of the Nile, that it has not been " permitted to mortals to see that river in a feeble state." If the letters above referred to had formed a part of this communication, I think the Secretary of the Academy would have sacrificed a fine comparison to an instructive fact. In other respects Conduit's *Memoir* did not convey much information that could be of use. His instructions to Fontenelle are curious enough; he bids him be sure to state, that Leibnitz had borrowed the Differential Calculus from the Method of Fluxions. He conjured him in another place not to omit to mention, that Queen Caroline used to delight much in the conversation of Newton, and nothing could do more honour to Newton than the commendation of a Queen, the Minerva of her age. Fontenelle was too much a philosopher, and a man of the world (and had himself approached too near to the persons of princes), to be of Mr Conduit's opinion, or to think that the approbation of the most illustrious princess could add dignity to the man who had made the three greatest discoveries yet known, and in whose hands the sciences of Geometry, Optics, and Astronomy, had all taken new forms. If he had been called to write the *Eloge* of the Queen of England, he would, no doubt, have remarked her relish for the conversation of Newton.

On the whole, the *Eloge* on Newton has great merit, and, to be the work of one who was at bottom a Cartesian, is a singular example of candour and impartiality.

[2] Birch's *History of the Royal Society*, Vol. III. p. 3.

on examination, found, that the rays had been acted on in passing the knife edges both by repulsive and attractive forces, and had begun to be so acted on in a sensible degree when they were yet distant by $\frac{1}{800}$ of an inch of the edges of the knives. His experiments, however, on this subject were interrupted, as he informs us, and do not appear to have been afterwards resumed. They enabled him, however, to draw this conclusion, that the path of the ray in passing by the knife edge was bent in opposite directions, so as to form a serpentine line, convex and concave toward the knife, according to the repulsive or attractive forces which acted at different distances; that it was also reasonable to conclude, that the phenomena of the refraction, reflection, and inflexion of light were all produced by the same force variously modified, and that they did not arise from the actual contact or collision of the particles of light with the particles of bodies.

The Third Book of the *Optics* concludes with those celebrated *Queries* which carry the mind so far beyond the bounds of ordinary speculation, though still with the support and under the direction either of direct experiment or close analogy. They are a collection of propositions relative chiefly to the nature of the mutual action of light and of bodies on one another, such as appeared to the author highly probable, yet wanting such complete evidence as might entitle them to be admitted as principles established. Such enlarged and comprehensive views, so many new and bold conceptions, were never before combined with the sobriety and caution of philosophical induction. The anticipation of future discoveries, the assemblage of so many facts from the most distant regions of human research, all brought to bear on the same points, and to elucidate the same questions, are never to be sufficiently admired. At the moment when they appeared, they must have produced a wonderful sensation in the philosophic world, unless, indeed, they advanced too far before the age, and contained too much which the comment of time was yet required to elucidate.

It is in the *Queries* that we meet with the ideas of this philosopher concerning the *Elastic Ether*, which he conceived to be the means of conveying the action of bodies from one part of the universe to another, and to which the phenomena of light, of heat, of gravitation, are to be ascribed. Here we have his conclusions concerning that polarity or peculiar virtue residing in the opposite sides of the rays of light, which he deduced from the enigmatical phenomena of doubly refracting crystals. Here, also, the first step is made toward the doctrine of elective attractions or of chemical affinity, and to the notion, that the phenomena of chemistry, as well as of cohesion, depend on the alternate attractions and repulsions existing between the particles of bodies at different

distances. The comparison of the gradual transition from repulsion to attraction at those distances, with the positive and negative quantities in algebra, was first suggested here, and is the same idea which the ingenuity of Boscovich afterwards expanded into such a beautiful and complete system. Others who have attempted such flights had ended in mere fiction and romance; it is only for such men as Bacon or Newton to soar beyond the region of poetical fiction, still keeping sight of probability, and alighting again safe on the *terra firma* of philosophic truth.[1]

Section IV.

ASTRONOMY.

The time was now come when the world was to be enlightened by a new science, arising out of the comparison of the phenomena of motion as observed in the heavens, with the laws of motion as known on the earth. Physical astronomy was the result of this comparison, a science embracing greater objects, and destined for a higher flight than any other branch of natural knowledge. It is unnecessary to observe, that it was by Newton that the comparison just referred to was instituted, and the riches of the new science unfolded to mankind.

This young philosopher, already signalized by great discoveries, had scarcely reached the age of twenty-four, when a great public calamity forced him into the situation where the first step in the new science is said to have been suggested; and that, by some of those common appearances in which an ordinary man sees nothing to draw his attention, nor even the man of genius, except at those moments of inspiration when the mind sees farthest into the intellectual world. In 1666, the plague forced him to retire from Cambridge into the country; and, as he sat one day alone, in a garden, musing on the nature of the mysterious force by which the phenome-

[1] The optical works of Newton are not often to be found all brought together into one body. The first part of them consists of the papers in the *Philosophical Transactions,* which gave the earliest account of his discoveries, and which have been already referred to. They are in the form of Letters to Oldenburg, the Secretary of the Society, as are also the answers, to Hooke, and the others who objected to these discoveries; the whole forming a most interesting and valuable series which Dr Horsely has published in the fourth volume of his edition of Newton's works, under the title of *Letters relating to the Theory of Light and Colours.* The next work, in point of time, consists of the *Lectiones Opticæ,* or the optical lectures which the author delivered at Cambridge. The *Optics,* in three books, is the last and most complete, containing all the reasoning concerning optical phenomena above referred to. The first edition was in 1704, the second, with additions, in 1717. *Newtoni Opera,* Tom. IV. Horsely's edition.

na at the earth's surface are so much regulated, he observed the apples falling spontaneously from the trees, and the thought occurred to him, since gravity is a tendency not confined to bodies on the very surface of the earth, but since it reaches to the tops of trees, to the tops of the highest buildings, nay, to the summits of the most lofty mountains, without its intensity or direction suffering any sensible change, Why may it not reach to a much greater distance, and even to the moon itself? And, if so, may not the moon be retained in her orbit by gravity, and forced to describe a curve like a projectile at the surface of the earth?[1]

Here another consideration very naturally occurred. Though gravity be not sensibly weakened at the small distances from the surface to which our experiments extend, it may be weakened at greater distances, and at the moon may be greatly diminished. To estimate the quantity of this diminution Newton appears to have reasoned thus: If the moon be retained in her orbit by her gravitation to the earth, it is probable that the planets are, in like manner, carried round the sun by a power of the same kind with gravity, directed to the centre of that luminary. He proceeded, therefore, to inquire, by what law the tendency, or gravitation of the planets to the sun must diminish, in order that, describing, as they do, orbits nearly circular round the sun, their times of revolution and their distances may have the relation to one another which they are known to have from observation, or from the third law of Kepler.

This was an investigation which, to most even of the philosophers and mathematicians of that age, would have proved an insurmountable obstacle to their farther progress; but Newton was too familiar with the geometry of evanescent or infinitely small quantities, not to discover very soon, that the law now referred to would require the force of gravity to diminish exactly as the square of the distance increased. The moon, therefore, being distant from the earth about sixty semidiameters of the earth, the force of gravity at that distance must be reduced to the 3600th part of what it is at the earth's surface. Was the deflection of the moon then from the tangent of her orbit, in a second of time, just the 3600th part of the distance which a heavy body falls in a second at the surface of the earth? This was a question that could be precisely answered, supposing the moon's distance known not merely in semidiameters of the earth but in feet, and her angular velocity, or the time of her revolution in her orbit, to be also known.

In this calculation, however, being at a distance from books, he took the common

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[1] Pemberton's *View of Newton's Philosophy*, Pref.

estimation of the earth's circumference that was in use before the measurement of Norwood, or of the French Academicians, according to which, a degree is held equal to 60 English miles. This being in reality a very erroneous supposition, the result of the calculation did not represent the force as adequate to the supposed effect; whence Newton concluded that some other cause than gravity must act on the moon, and on that account he laid aside, for the time, all farther speculation on the subject. It was in the true spirit of philosophy that he so readily gave up an hypothesis, in which he could not but feel some interest, the moment he found it at variance with observation. He was sensible that nothing but the exact coincidence of the things compared could establish the conclusion he meant to deduce, or authorize him to proceed with the superstructure, for which it was to serve as the foundation.

It appears, that it was not till some years after this, that his attention was called to the same subject, by a letter from Dr Hooke, proposing, as a question, To determine the line in which a body let fall from a height descends to the ground, taking into consideration the motion of the earth on its axis. This induced him to resume the subject of the moon's motion; and the measure of a degree by Norwood having now furnished more exact data, he found that his calculation gave the precise quantity for the moon's momentary deflection from the tangent of her orbit, which was deduced from astronomical observation. The moon, therefore, has a tendency to descend toward the earth from the same cause that a stone at its surface has; and if the descent of the stone in a second be diminished in the ratio of 1 to 3600, it will give the quantity by which the moon descends in a second, below the tangent to her orbit, and thus is obtained an experimental proof of the fact, that gravity decreases as the square of the distance increases. He had already found that the times of the planetary revolutions, supposing their orbits to be circular, led to the same conclusion; and he now proceeded, with a view to the solution of Hooke's problem, to inquire what their orbits must be, supposing the centripetal force to be inversely as the square of the distance, and the initial or projectile force to be any whatsoever. On this subject Pemberton says, he composed (as he calls it) a dozen propositions, which probably were the same with those in the beginning of the *Principia*,—such as the description of equal areas in equal times, about the centre of force, and the ellipticity of the orbits described under the influence of a centripetal force that varied inversely as the square of the distances.

What seems very difficult to be explained is, that, after having made trial of his strength, and of the power of the instruments of investigation which he was now in pos-

session of, and had entered by means of them on the noblest and most magnificent field of investigation that was ever yet opened to any of the human race, he again desisted from the pursuit, so that it was not till several years afterwards that the conversation of Dr Halley, who made him a visit at Cambridge, induced him to resume and extend his researches.

He then found, that the three great facts in astronomy, which form the laws of Kepler, gave the most complete evidence to the system of gravitation. The *first* of them, the proportionality of the areas described by the radius vector to the times in which they are described, is the peculiar character of the motions produced by an original impulse impressed on a body, combined with a centripetal force continually urging it to a given centre. The *second* law, that the planets describe ellipses, having the sun in one of the foci, common to them all, coincides with this proposition, that a body under the influence of a centripetal force, varying as the square of the distance inversely, and having any projectile force whatever originally impressed on it, must describe a conic section having one focus in the centre of force, which section, if the projectile force does not exceed a certain limit, will become an ellipse. The *third* law, that the squares of the periodic times are as the cubes of the distances, is a property which belongs to the bodies describing elliptic orbits under the conditions just stated. Thus the three great truths to which the astronomy of the planets had been reduced by Kepler, were all explained in the most satisfactory manner, by the supposition that the planets gravitate to the sun with a force which varies in the inverse ratio of the square of the distances. It added much to this evidence, that the observations of Cassini had proved the same laws to prevail among the satellites of Jupiter.

But did the principle which appeared thus to unite the great bodies of the universe act only on those bodies? Did it reside merely in their centres, or was it a force common to all the particles of matter? Was it a fact that every particle of matter had a tendency to unite with every other? Or was that tendency directed only to particular centres? It could hardly be doubted that the tendency was common to all the particles of matter. The centres of the great bodies had no properties as mathematical points, they had none but what they derived from the material particles distributed around them. But the question admitted of being brought to a better test than that of such general reasoning as the preceding. The bodies between which this tendency had been observed to take place were all round bodies, and either spherical or nearly so, but whether great or small, they seemed to gravitate toward one another according to the same law.

The planets gravitated to the sun, the moon to the earth, the satellites of Jupiter toward Jupiter; and gravity, in all these instances, varied inversely as the squares of the distances. Were the bodies ever so small—were they mere particles—provided only they were round, it was therefore safe to infer, that they would tend to unite with forces inversely as the squares of the distances. It was probable, then, that gravity was the mutual tendency of all the particles of matter toward one another; but this could not be concluded with certainty, till it was found, whether great spherical bodies composed of particles gravitating according to this law, would themselves gravitate according to the same. Perhaps no man of that age but Newton himself was fit to undertake the solution of this problem. His analysis, either in the form of fluxions or in that of prime and ultimate ratios, was able to reduce it to the quadrature of curves, and he then found, no doubt infinitely to his satisfaction, that the law was the same for the sphere as for the particles which compose it; that the gravitation was directed to the centre of the sphere, and was as the quantity of matter contained in it, divided by the square of the distance from its centre. Thus a complete expression was obtained for the law of gravity, involving both the conditions on which it must depend, the quantity of matter in the gravitating bodies, and the distance at which the bodies were placed. There could be no doubt that this tendency was always mutual, as there appeared nowhere any exception to the rule that action and reaction are equal; so that if a stone gravitated to the earth, the earth gravitated equally to the stone; that is to say, that the two bodies tended to approach one another with velocities which were inversely as their quantities of matter.[1] There appeared to be no limit to the distance to which this action reached; it was a force that united all the parts of matter to one another, and if it appeared to be particularly directed to certain points, such as the centres of the sun or of the planets, it was only on account of the quantity of matter collected and distributed uniformly round those points, through which, therefore, the force resulting from the composition of all those elements must pass either accurately or nearly.

A remarkable inference was deduced from this view of the planetary motions, giving a deep insight into the constitution of our system in a matter that seems the most recondite, and the furthest beyond the sphere which necessarily circumscribes human

[1] If M and M′ are the masses of two spheres, and x the distance of their centres, $\frac{M+M'}{x^2}$ is the accelerating force with which they tend to unite; but the velocity of the approach of M will be $\frac{M'}{x^2}$, and of M′, $\frac{M}{x^2}$.

knowledge. The quantity of matter, and even the density of the planets, was determined. We have seen how Newton compared the intensity of gravitation at the surface of the earth, with its intensity at the moon, and by a computation somewhat similar, he compared the intensity of the earth's gravitation to the sun, with the moon's gravitation to the earth, each being measured by the contemporaneous and momentary deflexion from a tangent to the small arch of its orbit. A more detailed investigation showed that the intensity of the central force in different orbits, is as the mean distance divided by the square of the periodic time; and the same intensity being also as the quantities of matter divided by the squares of the distances, it follows, that these two quotients are equal to one another, and that, therefore, the quantities of matter are as the mean distances divided by the squares of the periodic times. Supposing, therefore, in the instance just mentioned, that the ratio of the mean distance of the sun from the earth to the mean distance of the moon from the earth is given (which it is from astronomical observation); as the ratio of their periodic lines is also known, the ratio of the quantity of matter in the sun to the quantity of matter in the earth, of consequence is found, and the same holds good for all the planets which have satellites moving round them. Nothing certainly can be more unexpected than that the quantities of matter in bodies so remote, should admit of being compared with one another, and with the earth. Hence also their mean densities, or mean specific gravities, became known. For from their distances and the angles they subtended, both known from observation, their magnitudes or cubical contents were easily inferred, and the densities of all bodies are, as their quantities of matter, divided by their magnitude. The *Principia Philosophiæ Naturalis*, which contained all these discoveries, and established the principle of universal gravitation, was given to the world in 1687, an æra, on that account, for ever memorable in the history of human knowledge.

The principle of gravity which was thus fully established, and its greatest and most extensive consequences deduced, was not now mentioned for the first time, though for the first time its existence as a fact was ascertained, and the law it observes was discovered. Besides some curious references to weight and gravity, contained in the writings of the ancients, we find something more precise concerning it in the writings of Copernicus, Kepler, and Hooke.

Anaxagoras is said to have held that "the heavens are kept in their place by the rapidity of their revolution, and would fall down if that rapidity were to cease." [1]

[1] Cœlum omne vehementi circuitu constare, alias remissione lapsurum. (Diog. Laert. *in Anax.* Lib. II. Sect. 12.)

Plutarch, in like manner, says, the moon is kept from falling by the rapidity of her motion, just as a stone whirled round in a sling is prevented from falling to the ground.[1]

Lucretius, reasoning probably after Democritus, holds, that the atoms would all, from their gravity, have long since united in the centre of the universe, if the universe were not infinite so as to have no centre.[2]

An observation of Pythagoras, supposed to refer to the doctrine of gravity, though in reality extremely vague, has been abundantly commented on by Gregory and Maclaurin. A musical string, said that philosopher, gives the same sound with another of twice the length, if the latter be straitened by four times the weight that straitens the former; and the gravity of a planet is four times that of another which is at twice the distance. These are the most precise notices, as far as I know, that exist in the writings of the ancients concerning gravity as a force acting on terrestrial bodies, or as extending even to those that are more distant. They are the reveries of ingenious men who had no steady principles deduced from experience and observation to direct their inquiries; and who, even when in their conjectures they hit on the truth, could hardly distinguish it from error.

Copernicus, as might be expected, is considerably more precise. " I do not think," says he, " that gravity is anything but a natural *appetency* of the parts (of the earth) given by the providence of the Supreme Being, that, by uniting together, they may assume the form of a globe. It is probable, that this same affection belongs to the sun, the moon, and the fixed stars, which all are of a round form."[3]

The power which Copernicus here speaks of has nothing to do, in his opinion, with the revolutions of the earth or the planets in their different orbits. It is merely intended as an explanation of their globular forms, and the consideration that does the author most credit is, that of supposing the force to belong, not to the centre, but to all the parts of the earth.

Kepler, in his immortal work on the *Motions of Mars*, treats of gravity as a force acting naturally from planet to planet, and particularly from the earth to the moon. " If the moon and the earth were not retained by some animal or other equivalent force each in its orbit, the earth would ascend to the moon by a 54th part of the in-

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[1] *De facie in Orbe Lunæ.*

[2] Lib. I. v. 983.

[3] *Revolutionum*, Lib. I. cap. 9. p. 17.

terval between them, while the moon moved over the remaining 53 parts, that is, supposing them both of the same density."[1] This passage is curious, as displaying a singular mixture of knowledge and error on the subject of the planetary motions. The tendency of the earth and moon being mutual, and producing equal quantities of motion in those bodies, bespeaks an accurate knowledge of the nature of that tendency, and of the equality, at least in this instance, between action and reaction. Then, again, the idea of an animal force or some other equally unintelligible power being necessary to carry on the circular motion, and to prevent the bodies from moving directly toward each other, is very strange; considering that Kepler knew the inertia of matter, and ought, therefore, to have understood the nature of centrifugal force, and its power to counteract the mutual gravitations of the two bodies. In this respect, the great astronomer who was laying the foundation of all that is known of the heavens, was not so far advanced as Anaxagoras and Plutarch;—so slow and unequal are the steps by which science advances to perfection. The mutual gravity of the earth and moon is not supposed by Kepler to have any concern in the production of their circular motions; yet he holds the tides to be produced by the gravitation of the waters of the sea toward the moon.[2]

The length to which Galileo advanced in this direction, and the point at which he stopped, are no less curious to be remarked. Though so well acquainted with the nature of gravity on the earth's surface,—the object of so many of his researches and discoveries, and though he conceived it to exist in all the planets, nay, in all the celestial bodies, and to be the cause of their round figure, he did not believe it to be a power that extended from one of those bodies to another. He seems to have thought that gravity was a principle which regulated the domestic economy of each particular body, but had nothing to do with their external relations; so that he censured Kepler for supposing, that the phenomena of the tides are produced by the gravitation of the waters of the ocean to the moon.[3]

Hooke did not stop short in the same unaccountable manner, but made a nearer approach to the truth than any one had yet done. In his attempt to prove the motion of the earth, published in 1674, he lays it down as the principle on which the celestial motions are to be explained, that the heavenly bodies have an attraction or gravitation

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[1] On that supposition their quantities of matter would be as their bulks, or as 1 to 53.

[2] *Astronomia Stellæ Martis.* Introd. Parag. 8.

[3] Dial. 4to. Tom. IV. p. 325, Edit. de Padova.

toward their own centres, which extends to other bodies within the sphere of their activity; and that all bodies would move in straight lines, if some force like this did not act on them continually, and compel them to describe circles, ellipses, or other curve lines. The force of gravity, also, he considered as greatest nearest the body, though the law of its variation he could not determine. These are great advances;—though, from his mention of the sphere of activity, from his considering the force as residing in the centre, and from his ignorance of the law which it observed, it is evident, that beside great vagueness, there was much error in his notions about gravity. Hooke, however, whose candour and uprightness bore no proportion to the strength of his understanding, was disingenuous enough, when Newton had determined that law, to lay claim himself to the discovery.

This is the farthest advance that the knowledge of the cause of the celestial motions had made before the investigations of Newton; it is the precise point at which this knowledge had stopped; having met with a resistance which required a mathematician armed with all the powers of the new analysis to overcome. The doctrine of gravity was yet no more than a conjecture, of the truth or falsehood of which the measurements and reasonings of geometry could alone determine.

Thus, then, we are enabled accurately to perceive in what Newton's discovery consisted. It was in giving the evidence of demonstration to a principle which a few sagacious men had been sufficiently sharp-sighted to see obscurely or inaccurately, and to propose as a mere conjecture. In the history of human knowledge, there is hardly any discovery to which some gradual approaches had not been made before it was completely brought to light. To have found out the means of giving certainty to the thing asserted, or of disproving it entirely; and, when the reality of the principle was found out, to measure its quantity, to ascertain its laws, and to trace their consequences with mathematical precision,—in this consists the great difficulty and the great merit of such a discovery as that which is now before us. In this Newton had no competitor: envy was forced to acknowledge that he had no rival, and consoled itself with supposing that he had no judge.

Of all the physical principles that have yet been made known, there is none so fruitful in consequences as that of gravitation; but the same skill that had directed Newton to the discovery was necessary to enable him to trace its consequences.

The mutual gravitation of all bodies being admitted, it was evident, that while the planets were describing their orbits round the greatest and most powerful body in the system, they must mutually attract one another, and thence, in their revolutions, some

irregularities, some deviations from the description of equal areas in equal times, and from the laws of the elliptic motion might be expected. Such irregularities, however, had not been observed at that time in the motion of any of the planets, except the moon, where some of them were so conspicuous as to have been known to Hipparchus and Ptolemy. Newton, therefore, was very naturally led to inquire what the different forces were, which, according to the laws just established, could produce irregularities in the case of the moon's motion. Beside the force of the earth, or rather of the mutual gravitation of the moon and earth, the moon must be acted on by the sun ; and the same force which was sufficient to bend the orbit of the earth into an ellipse, could not but have a sensible effect on the orbit of the moon. Here Newton immediately observed, that it is not the whole of the force which the sun exerts on the moon that disturbs her motion round the earth, but only the difference between the force just mentioned, and that which the sun exerts on the earth,—for it is only that difference that affects the relative positions of the two bodies. To have exact measures of the disturbing forces, he supposed the entire force of the sun on the moon to be resolved into two, of which one always passed through the centre of the earth, and the other was always parallel to the line joining the sun and earth,—consequently, to the direction of the force of the sun on the earth. The former of these forces being directed to the centre of the earth, did not prevent the moon from describing equal areas in equal times round the earth. The effect of it on the whole, however, he showed to be, to diminish the gravity of the moon to the earth by about one 358th part, and to increase her mean distance in the same proportion, and her angular motion by about a 179th.

From the moon thus gravitating to the centre of the earth, not by a force that is altogether inversely as the square of the distance, but by such a force diminished by a small part that varies simply as the distance, it was found, from a very subtle investigation, that the dimensions of the elliptic orbit would not be sensibly changed, but that the orbit itself would be rendered moveable, its longer axis having an angular and progressive motion, by which it advanced over a certain arc during each revolution of the moon. This afforded an explanation of the motion of the apsides of the lunar orbit which had been observed to go forward at the rate of 3° 4′, nearly, during the time of the moon's revolution, in respect of the fixed stars.

This was a new proof of the reality of the principle of gravitation, which, however, was rendered less conclusive by the consideration that the exact quantity of the motion of the apsides observed, did not come out from the diminution of the moon's

gravity as above assigned. There was a sort of cloud, therefore, which hung over this point of the lunar theory, to dissipate which, required higher improvements in the calculus than it was given to the inventor himself to accomplish. It was not so with respect to another motion to which the plane of the lunar orbit is subject, a phenomenon which had been long known in consequence of its influence on the eclipses of the sun and moon. This was the retrogradation of the line of nodes, amounting to 3′ 10″ every day. Newton showed that the second of the forces into which the solar action is moved being exerted, not in the plane of the moon's orbit, but in that of the ecliptic, inclined to the former at an angle somewhat greater than five degrees, its effect must be to draw down the moon to the plane of the ecliptic sooner than it would otherwise arrive at it; in consequence of which, the intersection of the two planes would approach, as it were, toward the moon, or move in a direction opposite to that of the moon's motion, or become retrograde. From the quantity of the solar force, and the inclination of the moon's orbit, Newton determined the mean quantity of this retrogradation, as well as the irregularities to which it is subject, and found both to agree very accurately with observation.

Another of the lunar inequalities,—that discovered by Tycho, and called by him the *Variation,* which consists in the alternate acceleration and retardation of the moon in each quarter of her revolution, was accurately determined from theory, such as it is found by observation ; and the same is true as to the annual equation, which had been long confounded with the equation of time. With regard to the other inequalities, it does not appear that Newton attempted an exact determination of them, but satisfied himself with this general truth, that the principle of the sun's disturbing force led to the supposition of inequalities of the same kind with those actually observed, though whether of the same exact quantity it must be difficult to determine. It was reserved, indeed, for a more perfect state of the calculus to explain the whole of those irregularities, and to deduce their precise value from the theory of gravity. Theory has led to the knowledge of many inequalities, which observation alone would have been unable to discover.

While Newton was thus so successfully occupied in tracing the action of gravity among those distant bodies, he did not, it may be supposed, neglect the consideration of its effects on the objects which are nearer us, and particularly on the Figure of the Earth. We have seen that, even with the limited views and imperfect information which Copernicus possessed on this subject, he ascribed the round figure of the earth and of the planets to the force of gravity residing in the particles of these bodies. Newton,

on the other hand, perceived that, in the earth, another force was combined with gravity, and that the figure resulting from that combination could not be exactly spherical. The diurnal revolution of the earth, he knew, must produce a centrifugal force, which would act most powerfully on the parts most distant from the axis. The amount of this centrifugal force is greatest at the equator, and being measured by the momentary recess of any point from the tangent, which was known from the earth's rotation, it could be compared with the force of gravity at the same place, measured in like manner by the descent of a heavy body in the first moment of its fall. When Newton made this comparison, he found that the centrifugal force at the equator is the 289th part of gravity, diminishing continually as the cosine of the latitude, on going from thence toward the poles, where it ceases altogether. From the combination of this force, though small, with the force of gravity, it follows, that the line in which bodies actually gravitate, or the plumb-line, cannot tend exactly to the earth's centre, and that a true horizontal line, such as is drawn by levelling, if continued from either pole, in the plane of a meridian all round the earth, would not be a circle but an ellipse, having its greatest axis in the plane of the equator, and its least in the direction of the axis of the earth's rotation. Now, the surface of the ocean itself actually traces this level as it extends from the equator to either pole. The terraqueous mass which we call the globe must therefore be what geometers call an oblate spheroid, or a solid generated by the revolution of the elliptic meridian about its shorter axis.

In order to determine the proportion of the axes of this spheroid, a problem, it will readily be believed, of no ordinary difficulty, Newton conceived, that if the waters at the pole and at the equator were to communicate by a canal through the interior of the earth, one branch reaching from the pole to the centre and the other at right angles to it, from the centre to the circumference of the equator, the water in this canal must be *in equilibrio*, or the weight of fluid in the one branch just equal to that in the other. Including, then, the consideration of the centrifugal force which acted on one of the branches but not on the other, and considering, too, that the figure of the mass being no longer a sphere, the attraction must not be supposed to be directed to the centre, but must be considered as the result of the action of all the particles of the spheroid on the fluid in the canals; by a very subtle process of reasoning, Newton found that the longer of the two canals must be to the shorter as 230 to 229. This, therefore, is the ratio of the radius of the equator to the polar semiaxis, their difference amounting, according to the dimensions then assigned to the earth, to about $17\frac{1}{10}$ English miles.

In this investigation, the earth is understood to be homogeneous, or everywhere of the same density.

It is very remarkable, that though the ingenious and profound reasoning on which this conclusion rests is not entirely above objection, and assumes some things without sufficient proof, yet, when these defects were corrected in the new investigations of Maclaurin and Clairaut, the conclusion, supposing the earth homogeneous, remained exactly the same. The sagacity of Newton, like the *Genius* of Socrates, seemed sometimes to inspire him with wisdom from an invisible source. By a profound study of nature, her laws, her analogies, and her resources, he seems to have acquired the same sort of *tact* or *feeling* in matters of science, that experienced engineers and other artists sometimes acquire in matters of practice, by which they are often directed right, when they can scarcely describe in words the principle on which they proceed.

From the figure of the earth thus determined, he showed that the intensity of gravity at any point of the surface, is inversely as the distance of that point from the centre; and its increase, therefore, on going from the equator to the poles, is as the square of the sine of the latitude, the same ratio in which the degrees of the meridian increase.[1] As the intensity of gravity diminished on going from the poles to the equator, or from the higher to the lower latitudes, it followed, that a pendulum of a given length would vibrate slower when carried from Europe into the torrid zone. The observations of the two French astronomers, Varin and De Hayes, made at Cayenne and Martinique, had already confirmed this conclusion.

The problem which Newton had thus resolved enabled him to resolve one of still greater difficulty. The precession, that is, the retrogradation of the equinoctial points, had been long known to astronomers; its rate had been measured by a comparison of ancient and modern observations, and found to amount nearly to 50″ annually, so as to complete an entire revolution of the heavens in 25,920 years. Nothing seemed more difficult to explain than this phenomenon, and no idea of assigning a physical or mechanical cause for it had yet occurred, I believe, to the boldest and most theoretical astronomer. The honour of assigning the true cause was reserved for the most cautious of philosophers. He was directed to this by a certain analogy observed between the precession of the equinoxes and the retrogradation of the moon's nodes, a phenomenon to which his calculus had been already successfully applied. The spheroidal shell or ring of

[1] *Princip.* Lib. III. prop. 20.

matter which surrounds the earth, as we have just seen, in the direction of the equator, being one half above the plane of the ecliptic and the other half below, is subjected to the action of the solar force, the tendency of which is to make this ring turn on the line of its intersection with the ecliptic, so as ultimately to coincide with the plane of that circle. This, accordingly, would have happened long since, if the earth had not revolved on its axis. The effect of the rotation of the spheroidal ring from west to east, at the same time that it is drawn down toward the plane of the ecliptic, is to preserve the inclination of these two planes unchanged, but to make their intersection move in a direction opposite to that of the diurnal rotation, that is, from east to west, or contrary to the order of the signs.

The calculus in its result justified this general conclusion; 10″ appeared the part of the effect due to the moon's attraction, 40″ to the attraction of the sun; and I know not if there be any thing respecting the constitution of our system, in which this great philosopher gave a stronger proof of his sagacity and penetration, than in the explanation of this phenomenon. The truth, however, is, that his data for resolving the problem were in some degree imperfect, all the circumstances were not included, and some were erroneously applied, yet the great principle and scope of the solution were right, and the approximation very near to the truth. "Il a été bien servi par son genie," says the eloquent and judicious historian of astronomy; "l'inspiration de cette faculté divine lui a fait appercevoir des determinations, qui n'etoient pas encore accessibles; soit qu'il eût des preuves qu'il a supprimées, *soit qu'il eût dans l'esprit un sorte d'estime, une espèce de balance pour approuver certaines vérités, en pesant les verités prochaines, et jugeant les unes par les autres.*"[1]

It was reserved for a more advanced condition of the new analysis, to give to the solution of this problem all the accuracy of which it is susceptible. It is a part, and a distinguishing part, of the glory of this system, that it was susceptible of more perfection than it received from the hands of the author; and that the century and a half which has nearly elapsed since the first discovery of it has been continually adding to its perfection. This character belongs to a system which has truth and nature for its basis, and had not been exhibited in any of the physical theories that had yet appeared in the world. The philosophy of Plato and Aristotle were never more perfect than when they came from the hands of their respective authors, and a legion of commentators, with all their efforts, did nothing but run round perpetually in the same circle.

[1] Bailly, *Hist. de l'Astron. Mod.* Tom. II. livre xii. § 28.

Even Descartes, though he had recourse to physical principles, and tried to fix his system on a firmer basis than the mere abstractions of the mind, left behind him a work which not only could not be improved, but was such, that every addition attempted to be made destroyed the equilibrium of the mass, and pulled away the part to which it was intended that it should be attached. The philosophy of Newton has proved susceptible of continual improvement; its theories have explained facts quite unknown to the author of it; and the exertions of La Grange and La Place, at the distance of an hundred years, have perfected a work which it was not for any of the human race to begin and to complete.

Newton next turned his attention to the phenomena of the Tides, the dependence of which on the moon, and in part also on the sun, was sufficiently obvious even from common observation. That the moon is the prime ruler of the tide, is evident from the fact, that the high water, at any given place, occurs always nearly at the moment when the moon is on the same meridian, and that the retardation of the tide from day to day, is the same with the retardation of the moon in her diurnal revolution. That the sun is also concerned in the production of the tides is evident from this, that the highest tides happen when the sun, the moon, and the earth, are all three in the same straight line; and that the lowest, or neap tides, happen when the lines drawn from the sun and moon to the earth make right angles with one another. The eye of Newton, accustomed to generalize and to penetrate beyond the surface of things, saw that the waters of the sea revolving with the earth, are nearly in the condition of a satellite revolving about its primary; and are liable to the same kind of disturbance from the attraction of a third body. The fact in the history of the tides which seems most difficult to be explained, received, on this supposition, a very easy solution. It is known, that high water always takes place in the hemisphere where the moon is, and in the opposite hemisphere where the moon is not, nearly at the same time. This seems, at first sight, very unlike an effect of the moon's attraction; for, though the water in the hemisphere where the moon is, and which, therefore, is nearest the moon, may be drawn up toward that body, the same ought not to happen in the opposite hemisphere, where the earth's surface is most distant from the moon. But if the action of the moon disturb the equilibrium of the ocean, just as the action of one planet disturbs the motion of a satellite moving round another, it is exactly what might be expected. It had been shown, that the moon, in conjunction with the sun, has her gravitation to the earth diminished, and when in opposition to the sun has it diminished very nearly by the same quantity. The reason is, that at the conjunction,

or the new moon, the moon is drawn to the sun more than the earth is; and that, at the opposition, or full moon, the earth is drawn toward the sun more than the moon nearly by the same quantity; the relative motion of the two bodies is therefore affected the same way in both cases, and the gravity of the moon to the earth, or her tendency to descend toward it, is in both cases lessened.

It is plain, that the action of the moon on the waters of the ocean must be regulated by the same principle. In the hemisphere where the moon is, the water is more drawn toward the moon than the mass of the earth is, and its gravity being lessened, the columns toward the middle of the hemisphere lengthen, in consequence of the pressure of the columns which are at a distance from the middle point, of which the weight is less diminished, and towards the horizon must even be increased. In the opposite hemisphere, again, the mass of the earth is more drawn to the moon than the waters of that hemisphere, and their relative tendencies are changed in the same direction, and nearly by the same quantity. If the action of the moon on all the parts of the earth, both sea and land, were the same, no tide whatever would be produced.

Thus, the same analysis of the force of gravity which explained the inequalities of the moon, were shown by Newton to explain those inequalities in the elevation of the waters of the ocean to which we give the name of tides. On the principle also explained in this analysis, it is, that the attraction of the sun and moon conspire to elevate the waters of the ocean whether these luminaries be in opposition or conjunction. In both cases the solar and lunar tides are added together, and the tide actually observed is their sum. At the quadratures, or the first and third quarters, these two sides are opposed to one another, the high water of the lunar tide coinciding with the low water of the solar, and conversely, so that the tide actually observed is the difference of the two.

The other phenomena of the tides were explained in a manner no less satisfactory, and it only remained to inquire, Whether the quantity of the solar and lunar forces were adequate to the effect thus ascribed to them? The lunar force there were yet no data for measuring, but a measure of the solar force, as it acts on the moon, had been obtained, and it had been shown that in its mean quantity it amounted to $\frac{1}{178}$ of the force which retains the moon in her orbit. This last is $\frac{1}{3600}$ of the force of gravity at the earth's surface, and, therefore, the force with which the sun disturbs the moon's motion is $\frac{1}{178}\times\frac{1}{3600}$ of gravity at the earth's surface. This is the solar disturbing force on the moon when distant sixty semidiameters from the earth's centre, but on a body only one

semidiameter distant from that centre, that is, on the water of the ocean, the disturbing force would be sixty times less, and thus is found to be no more than $\frac{1}{38448000}$ of gravity at the earth's surface.

Now, this being the mean force of the sun, is that by which he acts on the waters, 90 degrees distant from the point to which he is vertical, where it is added to the force of gravity, and tends to increase the weight and lower the level of the waters. At the point where the sun is vertical, the force to raise the water is about double of this, and, therefore, the whole force tending to raise the level of the high, above that of the low water, is three times the preceding, or about the $\frac{1}{12816000}$ of gravity. Small as this force is, when it is applied to every particle of the ocean, it is capable of producing a sensible effect. The manner in which Newton estimates this effect can only be considered as affording an approximation to the truth. In treating of the figure of the earth, he had shown that the centrifugal force, amounting to $\frac{1}{289}$ of gravity, was able to raise the level of the ocean more than seventeen miles, or, more exactly, 85,472 French feet. Hence, making the effect proportional to the forces, the elevation of the waters produced by the solar force will come out 1.92 feet.

But, from the comparison of the neap and spring tides, that is, of the difference and the sum of the lunar and solar forces, it appears, that the force of the moon is to that of the sun as 4.48 to 1. As the solar force raises the tide 1.92 feet, the lunar will raise it 8.63 feet, so that the two together will produce a tide of $10\frac{1}{2}$[1] French feet, which agrees not ill with what is observed in the open sea, at a distance from land.

The calculus of Newton stopped not here. From the force that the moon exerts on the waters of the ocean, he found the quantity of matter in the moon to that in the earth as 1 to 39.78, or, in round numbers, as 1 to 40. He also found the density of the moon to the density of the earth as 11 to 9.

Subsequent investigations, as we shall have occasion to remark, have shown that much was yet wanting to a complete theory of the tides; and that even after Maclaurin, Bernoulli, and Euler[2] had added their efforts to those of Newton, there remained enough to give full employment to the calculus of Laplace. As an original deduction, and as a first approximation, that of which I have now given an account, will be for ever memorable.

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[1] Newtoni. *Prin.* Lib. III. Prop. 36 ad 37.

[2] See the solutions of these three mathematicians in the *Commentary* of Le Seur and Jacquier on the Third Book of the *Principia*.

The motion of Comets yet remained to be discussed. They had only lately been acknowledged to belong to the heavens, and to be placed beyond the region of the earth's atmosphere; but with regard to their motion, astronomers were not agreed. Kepler believed them to move in straight lines; Cassini thought they moved in the planes of great circles, but with little curvature. Hevelius had come much nearer the truth; he had shown the curvature of their paths to be different in different parts, and to be greatest when they were nearest the sun; and a parabola having its vertex in that point seemed to him to be the line in which the comet moved. Newton, convinced of the universality of the principle of gravitation, had no doubt that the orbit of the comet must be a conic section, having the sun in one of its foci, and might either be an ellipse, a parabola, or even an hyperbola, according to the relation between the force of projection and the force tending to the centre. As the eccentricity of the orbit on every supposition must be great, the portion of it that fell within our view could not differ much from a parabola, a circumstance which rendered the calculation of the comet's place, when the position of the orbit was once ascertained, more easy than in the case of the planets. Thus far theory proceeded, and observation must then determine with what degree of accuracy this theory represented the phenomena. From three observations of the comet, the position of the orbit could be determined, though the geometric problem was one of great difficulty. Newton gave a solution of it; and it was by this that his theory was to be brought to the test of experiment. If the orbit thus determined was not the true one, the places of the comet calculated on the supposition that it was, and that it described equal areas in equal times about the sun, could not agree with the places actually observed. Newton showed, by the example of the remarkable comet then visible (1680), that this agreement was as great as could reasonably be expected; thus adding another proof to the number of those already brought to support the principle of universal gravitation. The comets descend into our system from all different quarters in the heavens, and, therefore, the proofs that they afforded went to show, that the action of gravity was confined to no particular region of the heavens.

Thus far Newton proceeded in ascertaining the existence, and in tracing the effects, of the principle of gravitation, and had done so with a success of which there had been no instance in the history of human knowledge. At the same time that it was the most successful, it was the most difficult research that had yet been undertaken. The reasonings upward from the facts to the general principle, and again down from that principle to its effects, both required the application of a mathematical analysis which

was but newly invented; and Newton had not only the difficulties of the investigation to encounter, but the instrument to invent, without which the investigation could not have been conducted. Every one who considers all this, will readily join in the sentiment with which Bailly closes a eulogy as just as it is eloquent. *Si, comme Platon a pensé, il existoit dans la nature une echelle d'etres et de substances intelligentes jusqu'à l'Etre Supremê, l'espéce humaine, defendant ses droits, auroit une foule de grands hommes à presenter; mais Newton, suivi de ses vérités pures, montreroit le plus haut degré de force de l'esprit humain, et suffiroit seul pour lui assigner sa vrai placè.*[1]

Though the creative power of genius was never more clearly evinced than in the discoveries of this great philosopher, yet the influence of circumstances, always extensive and irresistible in human affairs, can readily be traced. The condition of knowledge at the time when Newton appeared was favourable to great exertions; it was a moment when things might be said to be prepared for a revolution in the mathematical and physical sciences. The genius of Copernicus had unfolded the true system of the world; and Galileo had shown its excellence, and established it by arguments, the force of which were generally acknowledged. Kepler had done still more, having, by an admirable effort of generalisation, reduced the facts concerning the planetary motions to three general laws. Cassini's observations had also extended the third of these laws to the satellites of Jupiter, showing that the squares of their periodic times were as the cubes of their distances from the centre of the body round which they revolved. The imaginary apparatus of cycles and epicycles,—the immobility of the earth,—the supposed essential distinction between celestial and terrestrial substances, those insuperable obstacles to real knowledge, which the prejudice of the ancients had established as physical truths, were entirely removed; and Bacon had taught the true laws of philosophising, and pointed out the genuine method of extracting knowledge from experiment and observation. The leading principles of mechanics were established; and it was no unimportant circumstance, that the *Vortices* of Descartes had exhausted one of the sources of error, most seducing on account of its simplicity.

All this had been done when the genius of Newton arose upon the earth. Never till now had there been set before any of the human race so brilliant a career to run, or so noble a prize to be obtained. In the progress of knowledge, a moment had

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[1] *Hist. de l'Astron. Mod.* Tom. II.

arrived more favourable to the developement of talent than any other, either later or earlier, and in which it might produce the greatest possible effect. But, let it not be supposed, while I thus admit the influence of external circumstances on the exertions of intellectual power, that I am lessening the merit of this last, or taking any thing from the admiration that is due to it. I am, in truth, only distinguishing between what it is possible, and what it is impossible, for the human mind to effect. With all the aid that circumstances could give, it required the highest degree of intellectual power to accomplish what Newton performed. We have here a memorable, perhaps a singular instance, of the highest degree of intellectual power, united to the most favourable condition of things for its exertion. Though Newton's situation was more favourable than that of the men of science who had gone before him, it was not more so than that of those men who pursued the same objects at the same time with himself, placed in a situation equally favourable.

When one considers the splendour of Newton's discoveries, the beauty, the simplicity, and grandeur of the system they unfolded, and the demonstrative evidence by which that system was supported, one could hardly doubt, that, to be received, it required only to be made known, and that the establishment of the Newtonian philosophy all over Europe would very quickly have followed the publication of it. In drawing this conclusion, however, we should make much too small an allowance for the influence of received opinion, and the resistance that mere habit is able, for a time, to oppose to the strongest evidence. The Cartesian system of vortices had many followers in all the countries of Europe, and particularly in France. In the universities of England, though the Aristotelian physics had made an obstinate resistance, they had been supplanted by the Cartesian, which became firmly established about the time when their foundation began to be sapped by the general progress of science, and particularly by the discoveries of Newton. For more than thirty years after the publication of those discoveries, the system of vortices kept its ground, and a translation from the French into Latin of the *Physics* of Rohault, a work entirely Cartesian, continued at Cambridge to be the text for philosophical instruction. About the year 1718, a new and more elegant translation of the same book was published by Dr Samuel Clarke, with the addition of notes, in which that profound and ingenious writer explained the views of Newton on the principal objects of discussion, so that the notes contained *virtually* a refutation of the text; they did so, however, only virtually, all appearance of argument and controversy being carefully avoided. Whether this escaped the notice of the learned Doctors or not is uncertain, but the

new translation, from its better Latinity, and the name of the editor, was readily admitted to all the academical honours which the old one had enjoyed. Thus, the stratagem of Dr Clarke completely succeeded; the tutor might prelect from the text, but the pupil would sometimes look into the notes, and error is never so sure of being exposed as when the truth is placed close to it, side by side, without any thing to alarm prejudice, or awaken from its lethargy the dread of innovation. Thus, therefore, the *Newtonian* philosophy first entered the university of Cambridge under the protection of the *Cartesian.*[1]

If such were the obstacles to its progress that the new philosophy experienced in a country that was proud of having given birth to its author, we must expect it to advance very slowly indeed among foreign nations. In France, we find the first astronomers and mathematicians, such men as Cassini and Maraldi, quite unacquainted with it, and employed in calculating the paths of the comets they were observing, on hypotheses the most unfounded and imaginary; long after Halley, following the principles of Newton, had computed tables from which the motions of all the comets that ever had appeared, or ever could appear, might be easily deduced. Fontenelle with great talents and enlarged views, and, as one may say, officially informed of the progress of science all over Europe, continued a Cartesian to the end of his days. Mairan in his youth was a zealous defender of the vortices, though he became afterwards one of the most strenuous supporters of the doctrine of gravitation.

A Memoir of the Chevalier Louville, among those of the Academy of Sciences for 1720, is the first in that collection, and, I believe, the first published in France, where the elliptic motion of the planets is supposed to be produced by the combination of

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[1] The universities of St Andrews and Edinburgh were, I believe, the first in Britain where the Newtonian philosophy was made the subject of the academical prelections. For this distinction they are indebted to James and David Gregory, the first in some respects the rival, but both the friends of Newton. Whiston bewails in the anguish of his heart the difference in this respect between those universities and his own. David Gregory taught in Edinburgh for several years prior to 1690, when he removed to Oxford; and Whiston says, "He had already caused several of his scholars to keep acts, as we call them, upon several branches of the Newtonian philosophy, while we at Cambridge (poor wretches) were ignominiously studying the fictitious hypotheses of the Cartesian." (Whiston's *Memoirs of his own Life.*) I do not, however, mean to say, that from this date the Cartesian philosophy was expelled from those universities; the *Physics* of Rohault were still in use as a text, at least occasionally, to a much later period than this, and a great deal, no doubt, depended on the character of the individual professors. Keil introduced the Newtonian philosophy in his lectures at Oxford in 1697; but the instructions of the tutors, which constitute the real and efficient system of the university, were not cast in that mould till long afterwards. The publication of S'Gravesende's *Elements* proves that the Newtonian philosophy was taught in the Dutch universities before the date of 1720.

two forces, one projectile and the other centripetal. Maupertuis soon after went much farther; in his elegant and philosophic treatise, *Figure des Astres*, published about 1730, he not only admitted the existence of attraction as a fact, but even defended it, when considered as an universal property of body, against the reproach of being a metaphysical absurdity. These were considerable advances, but they were made slowly; and it was true, as Voltaire afterwards remarked, that though the author of the *Principia* survived the publication of that great work nearly forty years, he had not, at the time of his death, twenty followers out of England.

We should do wrong, however, to attribute this slow conversion of the philosophic world entirely to prejudice, inertness, or apathy. The evidence of the Newtonian philosophy was of a nature to require time in order to make an impression. It implied an application of mathematical reasoning which was often difficult; the doctrine of prime and ultimate ratios was new to most readers, and could be familiar only to those who had studied the infinitesimal analysis.

The principle of gravitation itself was considered as difficult to be admitted. When presented indeed as a mere fact, like the weight of bodies at the earth's surface, or their tendency to fall to the ground, it was free from objection; and it was in this light only that Newton wished it to be considered.[1] But though this appears to be the sound and philosophical view of the subject, there has always appeared a strong desire in those who speculated concerning gravitation to go farther, and to inquire into the cause of what, as a mere fact, they were sufficiently disposed to admit. If you said that you had no explanation to give, and was only desirous of having the fact admitted; they alleged, that this was an unsatisfactory proceeding,—that it was admitting the doctrine of *occult causes*,—that it amounted to the assertion, that bodies acted in places where they were not,—a proposition that, metaphysically considered, was undoubtedly absurd. The desire to explain gravitation is indeed so natural, that Newton himself felt its force, and has thrown out, at the end of his *Optics*, some curious conjectures concerning this general affection of body, and the nature of that elastic ether to which he thought that it was perhaps to be ascribed. "Is not this medium (the ether) much rarer within the dense bodies of the sun, stars, and planets, than in the empty celestial spaces between them? And, in passing from them to great distances, does it

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[1] "*Vocem attractionis hic generalitor usurpo pro corporum conatu quocunque accedendi ad invicem; sive conatus iste fiat ab actione corporum se mutuo petentium, vel per spiritus emissos se mutuo agitantium; sive is ab actione ætheris, aut aeris medii cujuscunque, corporei vel incorporei oritur, corpora innatantia in si invicem utcunque impellentes.*" *Principia Math.* Lib. I. *Schol. ad finem.* prop. 69.

not grow denser and denser perpetually, and thereby cause the gravity of those great bodies to one another, every body endeavouring to go from the denser parts of the medium to the rarer?"[1]

Notwithstanding the highest respect for the author of these conjectures, I cannot find any thing like a satisfactory explanation of gravity in the existence of this elastic ether. It is very true that an elastic fluid, of which the density followed the inverse ratio of the distance from a given point, would urge the bodies immersed in it, and impervious to it, toward that point with forces inversely as the squares of the distances from it; but what could maintain an elastic fluid in this condition, or with its density varying according to this law, is a thing as inexplicable as the gravity which it was meant to explain. The nature of an elastic fluid must be, in the absence of all inequality of pressure, to become everywhere of the same density. If the causes that produce so marked and so general a deviation from this rule be not assigned, we can only be said to have substituted one difficulty for another.

A different view of the matter was taken by some of the disciples and friends of Newton, but which certainly did not lead to any thing more satisfactory. That philosopher himself had always expressed his decided opinion[2] that gravity could not be considered as a property of matter; but Mr Cotes, in the preface to the second edition of the *Principia*, maintains, that gravity is a property which we have the same right to ascribe to matter, that we have to ascribe to it extension, impenetrability, or any other property. This is said to have been inserted without the knowledge of

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[1] *Optics*, Query 21, at the end of the Third Book.

[2] The passages quoted sufficiently prove that Newton did not consider gravity as a property inherent in matter. The following passage in one of his Letters to Dr Bentley is still more explicit: "It is inconceivable that inanimate brute matter should, without the mediation of something else, which is not material, operate upon and affect other matter without mutual contact; as it must do, if gravitation, in the sense of Epicurus, be essential or inherent in it. That gravity should be innate, inherent, and essential to matter, so that one body may act on another, at a distance, through a vacuum, without the mediation of any thing else, by and through which their action and force may be conveyed from one to another, is, to me, so great an absurdity, that I believe no man who, in philosophical matters, has a competent faculty of thinking can ever fall into it." (*Newtoni Opera*, Tom. IV. Horseley's edit. p. 438.) On this passage I cannot help remarking, that it is not quite clear in what manner the interposition of a material substance can convey the action of distant bodies to one another. In the case of percussion or pressure, this is indeed very intelligible, but it is by no means so in the case of attraction. If two particles of matter, at opposite extremities of the diameter of the earth, attract one another, this effect is just as little intelligible, and the *modus agendi* is just as mysterious, on the supposition that the whole globe of the earth is interposed, as on that of nothing whatever being interposed, or of a complete vacuum existing between them. It is not enough that each particle attracts that in contact with it; it must attract the particles that are distant, and the intervention of particles between them does not render this at all more intelligible.

Newton,—a freedom which it is difficult to conceive that any man could use with the author of the *Principia*. However that be, it is certain that these difficulties have been always felt, and had their share in retarding the progress of the philosophy to which they seemed to be inseparably attached.

There were other arguments of a less abstruse nature, and more immediately connected with experiment, which, for a time, resisted the progress of the Newtonian philosophy, though they contributed, in the end, very materially to its advancement. Nothing, indeed, is so hostile to the interests of truth, as facts inaccurately observed; of which we have a remarkable example in the measurement of an arch of the meridian across France, from Amiens to Perpignan, though so large as to comprehend about seven degrees, and though executed by Cassini, one of the first astronomers in Europe. According to that measurement, the degrees seemed to diminish on going from south to north, each being less by about an 800th part than that which immediately preceded it toward the south. From this result, which is entirely erroneous, the conclusion first deduced was correct, the error in the reasoning, by a very singular coincidence, having corrected the error in the *data* from which it was deduced. Fontenelle argued that, as the degrees diminished in length on going toward the poles, the meridian must be less than the circumference of the equator, and the earth, of course, swelled out in the plane of that circle, agreeably to the facts that had been observed concerning the retardation of the pendulum when carried to the south. This, however, was the direct contrary of the conclusion which ought to have been drawn, as was soon perceived by Cassini and by Fontenelle himself. The degrees growing less as they approached the pole, was an indication of the curvature growing greater, or of the longer axis of the meridian being the line that passed through the poles, and that coincided with the axis of the earth. The figure of the earth must, therefore, be that of an oblong spheroid, or one formed by the revolution of an ellipsis about its longer axis. This conclusion seemed to be strengthened by the prolongation of the meridian from Amiens northward to Dunkirk in 1713, as the same diminution was observed; the medium length of the degree between Paris and Dunkirk being 56970 toises, no less than 137 less than the mean of the degrees toward the south.[1] All this seemed quite inconsistent with the observations on the pendulum, as well as with the conclusions which Newton had deduced from the theory of gravity. The Academy of Sciences was thus greatly perplexed, and uncertain to what side to incline. In

[1] *Memoires de l'Acad. des Sciences,* 1718, p. 245.

these circumstances, J. Cassini, whose errors were the cause of all the difficulty, had the merit of suggesting the only means by which the question concerning the figure of the earth was likely to receive a satisfactory solution,—the measurement of two degrees, the one under the equator, and the other as near to the pole as the nature of the thing would admit. But it was not till considerably beyond the limits of the period of which I am now treating, that these measures were executed; and that the increase of the degrees toward the poles, or the oblateness of the earth's figure, was completely ascertained. Cassini, on resuming his own operations, discovered, and candidly acknowledged, the errors in his first measurement; and thus the objections which had arisen in this quarter against the theory of gravity became irresistible arguments in its favour. This subject will occupy much of our attention in the history of the *second period*, till which, the establishment of the Newtonian philosophy on the Continent cannot be said to have been accomplished.

In addition to these discoveries in physical astronomy, this period affords several on the descriptive parts of the science, of which, however, I can only mention one, as far too important to be passed over in the most general outline. It regards the apparent motion in the fixed stars, known by the name of the Aberration, and is the discovery of Dr Bradley, one of the most distinguished astronomers of whom England has to boast. Bradley and his friend Molyneux, in the end of the year 1725,[1] were occupied in searching for the parallax of the fixed stars by means of a zenith sector, constructed by Graham, the most skilful instrument maker of that period. The sector was erected at Kew; it was of great radius, and furnished with a telescope twenty-four feet in length, with which they proposed to observe the transits of stars near the zenith, according to a method that was first suggested by Hooke, and pursued by him so far as to induce him to think that he had actually discovered the parallax of γ *Draconis*, the bright star in the head of the dragon, on which he made his observations. They began their observations of the transits of the same star on the 3d of December, when the distance from the zenith at which it passed was carefully marked. By the observations of the subsequent days the star seemed to be moving to the south; and about the beginning of March, in the following year, it had got 20″ to the south, and was then nearly stationary. In the beginning of June it had come back to the same situation where it was first observed, and from thence it continued its motion northward till Sep-

[1] *Phil. Trans.* Vol. XXXV. p. 697.

tember, when it was about 20″ north of the point where it was first seen, its whole change of declination having amounted to 40″.

This motion occasioned a good deal of surprise to the two observers, as it lay the contrary way to what it would have done if it had proceeded from the parallax of the star. The repetition of the observations, however, confirmed their accuracy; and they were afterwards pursued by Dr Bradley, with another sector constructed also by Graham, of a less radius, but still of one sufficiently great to measure a star's zenith distance to half a second. It embraced a larger arch, and admitted of the observations being extended to stars that passed at a more considerable distance from the zenith.

Even with this addition the observations did not put Bradley in possession of the complete fact, as they only gave the motion of each star in declination, without giving information about what change might be produced in its right ascension.

Had the whole fact, that is, the motion in right ascension as well as in declination been given from observation, it could not have been long before the cause was discovered. With such information, however, as Dr Bradley had, that discovery is certainly to be regarded as a great effort of sagacity. He has not told us the steps by which he was led to it; only we see that, by the method of exclusion, he had been careful to narrow the field of hypothesis, and had assured himself that the phenomenon was not produced by any nutation of the earth's axis; by any change in the direction of the plumb-line, or by refraction of any kind. All these causes being rejected, it occurred to him that the appearances might arise from the progressive motion of light combined with the motion of the earth in its orbit. He reasoned somewhat in this manner. If the earth were at rest, it is plain that a telescope, to admit a ray of light coming from a star to pass along its axis, must be directed to the star itself. But, if the earth, and, of course, the telescope be in motion, it must be inclined forward, so as to be in the diagonal of a parallelogram, the sides of which represent the motion of the earth, and the motion of light, or in the direction of those motions, and in the ratio of their velocities. It is with the telescope just as with the vane at the mast-head of a ship; when the ship is at anchor, the vane takes exactly the direction of the wind; when the ship is under weigh, it places itself in the diagonal of a parallelogram, of which one side represents the velocity of the ship, and the other the velocity of the wind. If, instead of the vane, we conceive a hollow tube, moveable in the same manner, the case will become more exactly parallel to that of the telescope. The tube

will take such a position that the wind may blow through it without striking against the sides, and its axis will then be the diagonal of the parallelogram just referred to.

The telescope, therefore, through which a star is viewed, and by the axis of which its position star is determined, must make an angle with the straight line drawn to the star, except when the earth moves directly upon the star, or directly from it. Hence it follows, that if the star be in the pole of the ecliptic, the telescope must be pointed forward, in the direction of the earth's motion, always by the same angle, so that the star would be seen out of its true place by that angle, and would appear to describe a circle round the pole of the ecliptic, the radius of which, subtended at the earth, an angle, of which the sine is to unity, as the velocity of the earth to the velocity of light. If the star be any where between the plane of the ecliptic and the pole, its apparent path will be an ellipse, the longer axis of which is the same with the diameter of the former circle, and the shorter equal to the same quantity, multiplied by the sine of the star's latitude. If the star be in the plane of the ecliptic, this shorter axis vanishes, and the apparent path of the star is a straight line, equal to the axis just mentioned.

Bradley saw that Römer's observation concerning the time that light takes to go from the sun to the earth gave a ready expression for the velocity of light compared with that of the earth. The proportion, however, which he assumed as best suited to his observations was somewhat different; it was that of 10313 to 1, which made the radius of the circle of aberration 20″, and the transverse axis of the ellipse in every case, or the whole change of position, 40″. It was the shorter axis which Bradley had actually observed in the case of γ *Draconis*, that star being very near the solstitial colure, so that its changes of declination and of latitude are almost the same. In order to show the truth of his theory, he computed the aberration of different stars, and, on comparing the results with his observations, the coincidence appeared almost perfect, so that no doubt remained concerning the truth of the principle on which he had founded his calculations. He did not explain the rules themselves: Clairaut published the first investigation of these in the *Memoirs of the Academy of Sciences* for 1737. Simpson also gave a demonstration of them in his *Essays*, published in 1740.

It has been remarked, that the velocity of light, as assumed by Bradley, did not exactly agree with that which Römer had assigned; supposing the total amount of the aberration 40½″, it gave the time that light takes to come from the sun to the earth 8′ 13″; but it is proper to add, that since the time of this astronomer, the

velocity of light deduced from the eclipses of Jupiter's satellites has been found exactly the same.

It is remarkable that the phenomenon thus discovered by Bradley and Molyneux, when in search of the parallax of the fixed stars, is in reality as convincing a proof of the earth's motion in its orbit, as the discovery of that parallax would have been. It seems, indeed, as satisfactory as any evidence that can be desired. One only regrets, in reflecting on this discovery, that the phenomenon of the aberration was not foreseen, and that, after being predicted from theory, it had been ascertained from observation. As the matter stands, however, the discovery both of the fact and the theory is highly creditable to its author.

In the imperfect outline which I have now sketched of one of the most interesting periods in the history of human knowledge, much has been omitted, and many great characters passed over, lost, as it were, in the splendour of the two great luminaries which marked this epocha. Newton and Leibnitz are so distinguished from the rest even of the scientific world, that we can only compare them with one another, though, in fact, no two intellectual characters, who both reached the highest degree of excellence, were ever more dissimilar.

For the variety of his genius, and the extent of his research, Leibnitz is perhaps altogether unrivalled. A lawyer, a historian, an antiquary, a poet, and a philologist,—a mathematician, a metaphysician, a theologian, and I will add a geologer, he has in all these characters produced works of great merit, and in some of them of the highest excellence. It is rare that original genius has so little of a peculiar direction, or is disposed to scatter its efforts over so wide a field. Though a man of great inventive powers, he occupied much of his time in works of mere labour and erudition, where there was nothing to invent, and not much of importance to discover. Of his inventive powers as a mathematician we have already spoken ; as a metaphysician, his acuteness and depth are universally admitted ; but metaphysics is a science in which there are few discoveries to be made, and the man who searches in it for novelty, is more likely to find what is imaginary than what is real. The notion of the *Monads*, those unextended units, or simple essences, of which, according to this philosopher, all things corporeal and spiritual, material or intellectual, are formed, will be readily allowed to have more in it of novelty than truth. The *pre-*

established harmony between the body and the mind, by which two substances incapable of acting on one another, are so nicely adjusted from the beginning, that their movements for ever correspond, is a system of which no argument can do more than prove the possibility. And, amid all the talent and acuteness with which these doctrines are supported, it seems to argue some unsoundness of understanding, to have thought that they could ever find a place among the established principles of human knowledge.

Newton did not aim at so wide a range. Fortunately for himself and for the world, his genius was more determined to a particular point, and its efforts were more concentrated. Their direction was to the accurate sciences, and they soon proved equally inventive in the pure and in the mixed mathematics. Newton knew how to transfer the truths of abstract science to the study of things actually existing, and, by returning in the opposite direction, to enrich the former by ideas derived from the latter. In experimental and inductive investigation, he was as great as in the pure mathematics, and his discoveries as distinguished in the one as in the other. In this double claim to renown, Newton stands yet unrivalled; and though, in the pure mathematics, equals may perhaps be found, no one, I believe, will come forward as his rival both in that science and in the philosophy of nature. His caution in adopting general principles; his dislike to what was vague or obscure; his rejection of all theories from which precise conclusions cannot be deduced; and his readiness to relinquish those that depart in any degree from the truth, are, throughout, the characters of his philosophy, and distinguish it very essentially from the philosophy of Leibnitz. The characters now enumerated are most of them negative, but without the principles on which they are founded, invention can hardly be kept in the right course. The German philosopher was not furnished with them in the same degree as the English, and hence his great talents have run very frequently to waste.

It may be doubted also, whether Leibnitz's great metaphysical acuteness did not sometimes mislead him in the study of nature, by inclining him to those reasonings which proceed, or affect to proceed, continually from the cause to the effect. The attributes of the Deity were the axioms of his philosophy; and he did not reflect that this foundation, excellent in itself, lies much too deep for a structure that is to be raised by so feeble an architect as man; or, that an argument, which sets out with the most profound respect to the Supreme Being, usually terminates in the most unwarrantable presumption. His reasonings from first causes are always ingenious; but

nothing can prevent the substitution of such causes for those that are physical and efficient, from being one of the worst and most fatal errors in philosophy.

As an interpreter of nature, therefore, Leibnitz stands in no comparison with Newton. His general views in physics were vague and unsatisfactory; he had no great value for inductive reasoning; it was not the way of arriving at truth which he was accustomed to take; and hence, to the greatest physical discovery of that age, and that which was established by the most ample induction, the existence of gravity as a *fact* in which all bodies agree, he was always incredulous, because no proof of it, *à priori*, could be given.

As to who benefited human knowledge the most, no question, therefore, can arise; and if genius is to be weighed in this balance, it is evident which scale must preponderate. Except in the pure mathematics, Leibnitz, with all his talents, made no material or permanent addition to the sciences. Newton, to equal inventions in mathematics, added the greatest discoveries in the philosophy of nature; and, in passing through his hands, Mechanics, Optics, and Astronomy, were not merely improved, but renovated. No one ever left knowledge in a state so different from that in which he found it. Men were instructed not only in new truths, but in new methods of discovering truth; they were made acquainted with the great principle which connects together the most distant regions of space, as well as the most remote periods of duration; and which was to lead to future discoveries, far beyond what the wisest or most sanguine could anticipate.

Supplement

TO THE

ENCYCLOPÆDIA BRITANNICA.

Edinburgh.

EDINBURGH. In the *Encyclopædia* will be found a full account of this City, till the year 1812; and we shall now give a short view of its improvements and increase since that period.

Ever since the year 1769, when the building of the New Town commenced, the improvement of Edinburgh has been prosecuted with extraordinary zeal, both by the magistrates and by the inhabitants; and, of late years more especially, the exertions of all ranks have been directed to this object. In consequence of this general and laudable spirit, the city of Edinburgh has not only been extended on all sides, but has been improved by the addition of some splendid public edifices; while the access to it from every quarter has been greatly facilitated and embellished.

New Streets.

In addition to the original streets of the New Town, namely, Prince's Street, George's Street, and Queen's Street, with their respective cross streets, and several other intermediate ones of inferior note, an important extension has been projected, and is now in part executing, on the inclined plane towards the north. The plan of these additional streets is nearly similar to that of the original part of the New Town, consisting chiefly of parallel rows of building, into which the improvement of incurved streets is tastefully introduced. Part of an interval of unoccupied ground between the old and these new streets, formerly private property, has been purchased, and is now open to the inhabitants of this quarter of the town, for whose convenience it has been tastefully laid out in walks, ornamented with trees; forming a garden view extremely pleasant to the eye from its verdure and beauty. Fronting this space, a very elegant street and crescent have been already built, together with several parallel and retiring streets; and this part of the town continues rapidly to increase. The ground, which, within these four last years, consisted of green fields, is now covered with elegant and spacious streets; other streets are in progress; and new and important additions are in contemplation, by which some of them will be prolonged eastward as far as Leith Walk.

New access from the East.

The inconvenience of the access to Edinburgh by the great London road was long a subject of general regret. In entering the city from this quarter, the road lay through narrow and inconvenient streets, forming an approach no way suited to the general elegance of the place. In the year 1814, active measures were at length adopted to remedy this defect. For this purpose, it was proposed to form a magnificent entrance across the Calton Hill, and this plan is now nearly completed. A spacious road, paved at an immense expence, has been carried quite across the hill;—in one part, a passage has been cut through the solid rock, and an immense mass of ground has been levelled, so as to facilitate the ascent. Between the Calton Hill and Prince's Street, a deep ravine intervened, which was formerly occupied with old and ill-built streets. In or-

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der to connect the hill with Prince's Street, all these have been swept away, and an elegant bridge of one arch has been thrown over the hollow, which makes the descent from the Hill into this street easy and agreeable. Thus, in place of being carried, as formerly, through long and narrow streets, the great road from the east into Edinburgh sweeps along the side of the singular and steep elevation of the Calton Hill; whence the traveller has first a view of the Old Town, with its elevated buildings crowning the summit of the adjoining ridges, and rising upon the eye in imposing masses; and, afterwards, of the New Town finely contrasted with the Old, in the regularity and elegance of its general outline. The Calton Hill is a singularly striking and romantic object, and in laying it out, there is ample scope for picturesque effect. In the late improvements this has not been neglected. Walks at different elevations have been cut around it, from which is seen, to great advantage, the Old and New Town projected on the plain below; while, at a greater distance, the eye ranges over a wide extent of the adjacent country, viewing in the north and east the Frith of Forth, the high grounds of Fife, and the German Ocean, and towards the south and west, a wide extent of cultivated plains terminated by distant hills.

Plan of Building on the Calton Hill.

According to a plan which has been drawn out by Mr William Playfair, a young architect of the greatest promise, the ground which lies between the Calton Hill and Leith is proposed to be laid out in new streets; and some farther embellishments are to be added to the Hill for the purpose of making it subservient to the general effect of the intended improvements. On the grand road, which is just begun, and which is to run along the bottom of the Hill on the north, it is proposed to build a large crescent, from which three main streets will diverge towards the town. The northern side of the main road being left partly unbuilt, an excellent situation will be obtained for public buildings; and it is proposed that a building of this description should be erected as an appropriate termination to each of the principal streets just mentioned. Above these public buildings, a handsome row or terrace is to be built, sufficiently elevated to overlook the houses below, and to present an extensive prospect of the more distant country. It is intended that this terrace should sweep round by an easy curve into a long line of building, proposed to be ranged along the side of the Regent Road on the opposite side of the hill; and that the space between this and the Regent Road should be converted into gardens, which, when properly laid out and planted, will become an agreeable and inviting retirement; and will, at the same time, present a pleasing foreground to the delightful scenery which is to be seen from the public walks above. In planning the ground along Leith Walk, it is proposed, in like manner, that squares and incurved streets, should be tastefully introduced, that the eye may be relieved from the dull uniformity which is presented by the constant recurrence of the same regular parallels. Besides these improvements, the Eastern Road, which forms one of the great communications with Leith, will be considerably widened, and four rows of trees planted along its whole length, in order to convert it into an agreeable walk for the inhabitants.

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This extension of the city is, however, only in contemplation. But there are other improvements equally important which are either already executed or in progress.

Progress of the New College.

The *Encyclopædia* contains an account of the University; and it is stated, that the original structure was partly taken down to make way for one more suited to the taste of modern times, and capable of accommodating the increasing concourse of students which the growing celebrity of this seminary was attracting from all parts. A most magnificent and extensive pile was begun, the funds for which were to be supplied by subscription. But it was soon found, that this work was planned on too extensive a scale, and the money collected being exhausted, the progress of the work was interrupted, and the building remained, in consequence, for a long time in a most awkward and unfinished state, a deformity, in place of an ornament, to the metropolis. By the liberality of Government a grant of public money has been obtained, and the work has been recommenced on a reduced, and it may, perhaps, be added, an improved plan, furnished by Mr Playfair. According to the original plan of Mr Adam, the interior space inclosed by the buildings of the University was divided into two courts or areas by a central range of buildings. In the new plan this range of buildings is left out, and the whole interior space is thrown into an open court; and such alterations and additions have been introduced, as were necessary to obviate incongruities, and to give to the whole an aspect of perfect uniformity. The access into the court is through a spacious gateway; and a person entering will have, on the one hand, a view of the buildings containing the library, and on the other those occupied by the rooms for the accommodation of the classes; while opposite to him will be the museum, the front of which is finely ornamented with Corinthian columns, resting on a rusticated arcade.

With respect to its interior arrangements, this edifice is laid out in suitable apartments for the library, the museum, the graduation hall, and chapel, and class rooms for the professors. According to the new plan, the library will be divided into two stories, the lower of which will be separated into five compartments, communicating with each other by folding doors. The anti-room will form a spacious apartment, forty-seven feet long, twenty-four feet wide, and twenty-two feet high, well lighted by a large window from the court. The next apartment is of a circular form, forty feet in diameter and sixty-four feet in height, lighted from the top, and having a gallery running round it. Farther on is the central room, sixty feet long, forty-seven feet wide, and twenty-two feet high, which is intended to be fitted up as a graduation hall and chapel. Beyond this are two rooms to correspond to the circular room and the outer room already described. The upper compartment of the library is on a plan similar to the one below, with this exception, that the central di-

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vision is thirty feet in height, having an arched ceiling supported by sixteen Corinthian columns. In place, also, of a division into compartments, the whole is thrown into one great room; so that the eye ranges from one extremity to the other, extending to a distance of 190 feet; the circular rooms with their domes, and the centre compartment with its arched ceiling, producing a noble variety, while the columns with their unbroken entablature, will give simplicity and coherence to the whole. The museum for specimens of natural history, the stock of which is daily accumulating, occupies two large rooms in different stories. The lower room is ninety feet long, thirty-four feet wide, and twenty-four feet high. It is proposed to furnish it in a simple and appropriate manner, the ceiling being left quite plain, and supported by Doric columns. The upper apartment is of the same length and breadth as the one below; but is considerably higher as it extends upwards towards the roof. In the middle of it is a dome 22 feet in diameter, the centre of which is occupied by a sky-light, from which and from other points an abundant supply of light is obtained for the exhibition of the specimens.

The rooms appropriated to the different classes are conveniently disposed on the intermediate floors between the pavement floor and the attics. The following is the number of students that have attended the University for the last four years: In 1814, 2029; 1815, 2097; 1816, 2025; 1817, 2024; and in 1818, 2160.

New Libraries.

That large and irregular pile of building in the Parliament Square, in which the Supreme Courts hold their sittings for the administration of justice, has lately received various additions and improvements. In the interior, great reparations have been made, and the front has been replaced by another, with an elegant piazza. Attached to the north-west corner of the Parliament House, magnificent apartments have lately been finished for the reception of the Advocates' Library, and that of the Writers to the Signet. The room appropriated to the latter, which is 105 feet in length, is divided into two parts, by means of open arches, the first of the compartments being oblong, and the second square. The ceiling of the oblong division is supported by two rows of Corinthian columns, which, besides being in themselves highly elegant and ornamental, completely obviate the want of height, which might otherwise have in some degree marred the general appearance of so large a room. On entering the great door, the colonnade continued for seven intercolumniations, without any break or interruption, produces a simple and noble effect, and through the ornamented arches by which this part of the hall is separated from the inner apartment, the latter appears rich and magnificent. Nor is the view from the upper end of the room at all inferior, the colonnade as seen through the arch receding from the eye in regular and beautiful gradation. The room over this is appropriated to the Advocates' Library, and is about 25 feet longer. It is loftier, and more gorgeously ornamented; but the general effect is not so pleasing. Both were executed from designs furnished by the late Mr William Stark, who has left some other noble monuments of his genius in the public buildings of Glasgow.

New Churches.

Several new churches have been erected in Edinburgh of very elegant architecture. St George's Church, which was opened for divine service in June 1814, presents a front to Charlotte Square of 112 feet, with a portico, supported by four Ionic columns, 35 feet in height, elevated on a flight of steps. A dome, 48 feet square, rises from a basement behind the portico, above which is a circular row of columns, surmounted by the upper compartments of the dome; and the whole is crowned by a lantern, with a cross, 160 feet from the ground. This church is favourably situated for effect, and, viewed from particular points, and at a distance, it appears a grand and striking object. It is, however, greatly surpassed in elegance of architecture by the two Episcopal chapels of St Paul's and St John's, opened for divine service in the year 1818. The chapel of St Paul's is finished in the style of Gothic architecture, which prevailed in the reign of Henry VI., during which period it had reached its greatest perfection. It is 122 feet in length, by 73 feet over the walls, and resembles in its form that of King's College, Cambridge, with this difference, however, that the circles are wider in proportion, and the octagon towers more ornamented. Although this style of architecture is susceptible of the highest decoration, the design of this chapel is remarkable, chiefly for the simplicity and continuity of its parts; and it is in vain that we look for the same striking effect in any of the edifices executed at the commencement, or during the decline of this style of architecture. The building consists of a nave and two side aisles. The interior dimensions are 105 feet by 63 feet; the nave is 105 feet by 26 feet, and 46 feet high; the two aisles are each 79 feet by 13 feet 6 inches, and 29 feet high. The ceiling of the nave is a flat Gothic arch, with ornamented ribs and tracery mouldings. The ceilings over the galleries are ornamented in the same manner, and those under the galleries are decorated with perforated ribs, and head and point ornaments. The altar window, which is 32 feet high, by 13 feet wide, is ornamented with a flaming cross, pendant, amid a wreath of clouds, and the opposite window is set with coloured glass. Over the buttresses of the outer and inner walls are richly carved pinnacles; and on each side of the two principal windows a graceful octagonal tower ascends to the height of 75 feet. This edifice was designed by Mr Elliot, and the plan and execution reflect great credit on his taste and talents. It was begun in 1816, and finished in 1818, at an expence of L. 12,000. The chapel of St John, which stands at the west end of Prince's Street, and which is built from a design by Mr Burn, architect, is generally regarded as a fine specimen of Gothic architecture. Its form is that of a parallelogram, running east and west, with a projection in front 150 feet. The chapel is 109 feet in length, by 66 in breadth. The east end is embellished with a large window, nearly 30 feet high, which, with the lofty Gothic tower, has a striking effect when seen from a distance. The finishing of the roof, in the interior of the nave, is in

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the florid Gothic style, similar to Henry the Seventh's Chapel, and is finely softened by the orange-coloured light of the upper windows. There are no galleries to break the continuity of the general appearance, which is at once grand and simple. In addition to those churches, a Roman Catholic chapel has been lately built at the end of York Place, in the purest style of Gothic architecture. An elegant church for an Antiburgher congregation has been erected in Nicholson's Street, in the same style of architecture.

New Observatory.

The want of an Observatory was long a subject of regret among the men of science in Edinburgh; and so early as the year 1736, a building of this nature was begun, but, from various causes, it was not prosecuted to a conclusion. In the year 1812, an Astronomical Institution was formed partly for the purposé of remedying this want; and, on the 25th April 1818, the foundation-stone of an Observatory was laid on the Calton Hill, in order, as is expressed on the plate deposited at the foundation, "that a great city, renowned for luxury and knowledge, might no longer be without the means of cultivating the most sublime and most perfect of the sciences." The building, the plan of which was furnished by Mr Playfair, is in the shape of a cross, formed by four Doric porticoes facing the four quarters of the heavens, and consisting each of six columns elevated upon steps. The interior contains an entrance-hall, with a staircase adjoining, a room for the accommodation of the observer, and the great room for the astronomical instruments, which consist of a transit instrument, an astronomical circle, and a mural circle. These are to rest on massive stone piers, which are founded on the solid rock, and every precaution is taken to prevent vibration. The roof is intersected by apertures for the mural circle, and for the transit instrument, and a moveable dome is provided for the astronomical circle.

New Prison.

The old Tolbooth, which was originally intended for the Parliament of Scotland, and the Courts of Justice, and which, with the buildings connected with it, long remained an encumbrance on the High Street, was taken down in the year 1817; previous to which a new prison was finished on the Calton Hill, in every respect better calculated both for the security and comfort of the prisoners. It is an extensive building, the ground-floor of which is divided into seven compartments, each containing a good day-room and a court-yard, the court-yards meeting at a point, at which is placed a watch-house. Above the watch-house, on a steep hill impending over the prison, is the governor's house, a most imposing structure, which completely overlooks the several yards. The upper stories of the building are occupied by the night cells of the different prisoners, ranged on both sides of long galleries. An infirmary is attached to the prison, and also a chapel, in which a clergyman is appointed to officiate. The outward aspect of the building is heavy, and serves to impress on the mind of the spectators the gloomy purpose for which it is erected.

Water and Gas Light Companies.

Owing to the great extension of Edinburgh, and to the improvements introduced into the interior economy of the houses, the supply of water brought into the city has of late years been found insufficient for the use of its increasing inhabitants; and a great scarcity of this necessary article has been experienced at different times. To remedy this grievance a joint stock company has been established, with a capital of L. 135,000. There are several springs at the distance of about eight miles, in the Pentland Hills, which it is proposed to bring into the city at the estimated expence of L. 85,000, to be defrayed by an increased rate of duty on the houses. A company has also been established for lighting the streets and shops with gas. Their capital amounts to L. 100,000, and the principal streets and warehouses have already received the full benefit of this improvement.

Leith Docks.

At Leith, which is the sea-port of Edinburgh, great improvements have been executed for the accommodation of the increasing trade. In 1800, a magnificent suite of wet-docks was planned; and the first of these beautiful basins, 250 yards in length by 100 in breadth, and sufficient to accommodate 40 ships of 200 tons, was opened in 1806; a second was opened in 1817, and it is intended to have another dock, equal in size to the two former, which will be sufficient for the accommodation of frigates. The two docks, already finished, have cost L. 250,000.

General Observations.

Edinburgh is in no respect a trading or manufacturing town. Being the seat of the supreme Courts of Justice for Scotland, and also of a celebrated university, with other important institutions for education, it is chiefly supported by the numerous retainers of these establishments. Law is the leading profession, and those who are connected with it are divided into different classes, namely, Advocates, who plead before the courts, Writers to the Signet, who form the great body of conveyancers, with certain valuable exclusive privileges, and Writers, a generic name for all those who act as solicitors, whether before the supreme or inferior Courts. A considerable class, also, depends on the university and other seminaries; and the constant residence in Edinburgh of so many persons attached to the learned professions has produced a most favourable influence on the minds and character of the inhabitants, and has given generally to the society of this metropolis a tone and polish not to be found in any mercantile place. Edinburgh is also the resort of rank and fashion, as well as of literature and taste. Many opulent families make it their winter residence, partly for the sake of educating their children, and also for the purpose of introducing them on easy terms into the circles of fashionable society. The manufactures of Edinburgh are chiefly of the finer sort, and such as tend to minister to the immediate wants of a refined and luxurious population. They consist of household furniture, travelling carriages, the construction of musical instruments, &c. There are also manufactures of glass, marble, brass, and iron. Two distilleries are established in the neighbourhood, and Edinburgh has always been noted for excellent ale. The trade of Bookselling and Printing has of late years increased to a great extent, and various periodical and other works have been published, some of which have deservedly attained the most extensive celebrity.

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Of these the principal is the *Edinburgh Review*, which circulates quarterly 15,000 copies. There are also two monthly magazines, a Monthly Review, besides eight Newspapers, three published thrice a-week, two twice, and three once a-week. The King's printing office, which has the exclusive right of printing Bibles, annually throws off 100,000 copies. (o.)

EDINBURGHSHIRE, or, as it is frequently called, MID-LOTHIAN, the seat of the metropolis of North Britain. It is situated between 55° 39′ and 55° 59′ north latitude, and between 2° 36′ and 3° 33′ longitude west from Greenwich. Its boundaries are the Frith of Forth on the north; Linlithgowshire or West-Lothian on the west; the counties of Haddington or East-Lothian, Berwick, and Roxburgh on the east; and those of Selkirk, Peebles, and Lanark on the south; the length of the whole line, which is very irregular and longest on the south, being about 90 miles. The medium length of the county may be taken at 24 miles, and the breadth 15, the area thus comprising 360 square miles, or, by the latest computation, 354 square miles, or 226,560 English acres, of which 145,000, or 64 acres in a hundred, are in cultivation, and the remainder, or more than a third, hilly, or otherwise comparatively unproductive.

Situation.

Extent.

Surface.

The surface of this county exhibits a great variety of natural scenery, almost everywhere blended and embellished with the labours of taste and opulence. The lower and richer part of it is of a semicircular form, inclining towards the Frith of Forth on the north, and terminating near Mid Calder on the west, and Fala on the south-east, but interrupted by the Pentland Hills, which, rising in the south-west, approach to within five miles of the frith, and thus divide the southern part of this tract into two large plains. These hills cover about 40 square miles, and though none of them rise to the height of more than 1700 feet, yet their situation in a flat country, and bleak and barren aspect, render them very prominent objects in the landscape. On the south-east, where the county terminates almost in a point, between Roxburgh and Selkirk shires, and about 15 miles from the sea, there is another mountainous tract, called the Morefoot Hills, the highest of which rise to upwards of 1800 feet, and extend over 50 square miles. From the rivulet Gala, which flows through it, this is commonly known by the name of the Gala Water district. Fertile valleys are found among these hills, and many of the hills themselves have been cultivated. With the exception of these two hilly tracts, Edinburghshire may be considered as a low lying country, though not level or flat, the surface being varied by ridges and gentle acclivities, and occasionally by detached hills of moderate elevation, among which Arthur's Seat, in the vicinity of Edinburgh, and the Corstorphine Hills, are the most considerable. The view from these eminences is singularly rich and beautiful, embracing, besides the city itself, a great many gentlemen's seats, with their pleasure grounds, and elegant villas thickly planted in every direction,—with the town and shipping of Leith, and the estuary of the Forth expanding into the ocean on the north and north-east, and the plains and high grounds of Fife beyond,—while the naked and rugged hills to the south form a striking contrast with the highly ornamented landscape into which they protrude.

Climate.

The climate is exceedingly variable, but not subject to extremes. Snow seldom falls before December. From March to June, cold east winds often prevail, sometimes attended by great falls of rain. July and August are warm and pleasant. Partly from the nature of the soil, as well as the climate, the corn crops do not come to maturity so soon as in the south of Scotland by three weeks or a month. The fields, in late seasons, are not all cleared, even near the city, till the end of October. According to a register kept in its immediate vicinity, for eight years, from 1785 to 1792, inclusive, the average number of rainy days was 175, and the quantity of rain 25.75 inches. The thermometer once in the same period was at 89°, and twice besides above 80°; the lowest point 11°; and the average of the whole period was 46.570.

Waters.

The streams of this county are so inconsiderable as not to be called rivers, but *waters*, a term which in Scotland is employed to denote a stream somewhat larger than a brook or *burn*, and whose bed is never in ordinary seasons altogether dry. Almond water, which rises in the borders of Lanarkshire, separates this county from Linlithgowshire for a great part of its course, and falls into the sea near the village of Cramond, where, at high water, it is navigable by sloops for about a quarter of a mile. The water of *Leith* has its source in the western extremity of the parish of Currie, on the north side of the Pentland Hills, and falls into the sea at Leith, after a course of about 16 miles. It flows in a deeper channel than the former; the banks are, for the most part, beautifully fringed with wood. In no part of the island perhaps is so small a body of water employed with greater effect, there being upwards of seventy mills, the greater number corn mills, on ten miles of its course. The Esk is the most considerable rivulet, and also the most beautiful. It is formed of two others of the same name, called the North Esk and the South Esk. The North Esk rises on the southern side of the Pentland Hills, above Newhall, about 14 miles from Edinburgh, and flows by Pennicuik, Roslin, Hawthornden, Laswade, and Melville Castle, till it meets with the South Esk below Dalkeith. The South Esk has its source in the Morefoot Hills. On its banks, which are also well wooded and picturesque, stand Arniston, Dalhousie, and Newbattle. Their united streams flow into the sea at Musselburgh. The Tyne, which rises in this county, after a course of five or six miles in a north-east direction, passes into East-Lothian; and the Gala, the only rivulet that flows to the south, rising on the north of the Morefoot Hills, leaves this county after it has proceeded about 10 miles, and falls into the Tweed below Galashiels. The Esks and the Gala contain trout, and salmon are caught in the Esk at Musselburgh; but the quantity of either is not considerable.

Minerals.

Coal.

Edinburghshire abounds in coal, limestone, and sandstone, or, as it is popularly called, *freestone*. A continued bed of coal extends across the whole county from Carlops, on the confines of Tweeddale or Peebles-shire, in a direction from south-west to

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north-east, nearly 15 miles in length, and from seven to eight in breadth, on both sides of the North Esk But it is chiefly towards the lower end of this vale that the coal is wrought, where there are in some places 26 seams, from two to ten feet thick. Some of the seams are horizontal, and others almost perpendicular, from which they are distinguished by the names of *flat* seams and *edge* seams; and it has been remarked, that the position of the coal corresponds in some degree with the surface of the ground, being level in the valley of the North Esk, and inclined to the horizon on the higher grounds at a distance. Coal has been wrought in the parish of Laswade for upwards of two centuries, where it is still so abundant, that the quantity raised is said to be equal to a sixth part of what is obtained from all the coal works of the county. Limestone is found not only in the same tract with the coal, but still farther to the east, and also in the south-west, where coal has not yet been discovered. The great quarry at Gilmerton, in the parish of Libberton, about four miles from Edinburgh, is nearly a mile in length, everywhere open to the light of day, and has the appearance of a long chasm, advancing obliquely to the surface. Like the coal in its neighbourhood, the stone rests in an inclined position, which, when removed, leaves a floor of such a moderate declivity as to be descended by paths among the fragments of rock that have been left. At the bottom there is a pool of water. Overhead is a roof of considerable height, consisting of a bed of solid rock, supported by pillars of limestone. The principal freestone quarries are at Craigleith, in the neighbourhood of the city, from which the six columns in the front of the New College were obtained, and at Hales, in the parish of Colinton, about three miles to the westward. The stone of the former, from its superior whiteness, has been of late most in request for building, but the latter is still unrivalled for flags and for stairs. A stone similar to that of Craigleith, but easier wrought, is now got at Redhall, also in the parish of Colinton. Mill-stones have been wrought in the parish of Pennicuik. Copper has been found in the parish of Currie and some other places, but not so rich as to pay for working. Iron stone abounds in the coal district, and also along the shore from Leith westwards, and stones for building and paving in every parish of the county. A stone similar to the Chinese *Petunse*, used in the manufacture of porcelain, has been found in the Pentland Hills, and clay, fit for being made into crucibles, in the parish of Duddingstone. There are mineral waters in different parts, none of which are of much celebrity. St Bernard's Well, to the north-west of the city, rose into some repute a few years ago, chiefly by means of the late Lord Gardenstone, but it is now resorted to rather as the termination of an agreeable walk than for its medicinal properties.

Valuation and Rental.

The valuation of Edinburghshire, which appears to have been taken in 1649, is L.191,054, 3s. 9d. Scots, and in 1811, the real rent of the lands, according to the returns made under the property-tax, was L.277,827, 19s. 1d. Sterling, and of the houses, L.400,004, 5s. 6d. In 1795, the landed property was divided into 542 estates, of which 12 belonged to hospitals and other corporate bodies, of the valued rent of L.10,628, 4s. 5d. Scots, or more than an eighteenth part of the whole. Here, as throughout the rest of Scotland, the land is occupied by tenants on leases for a term of years, excepting the comparatively small portion possessed by the proprietors themselves, or let in grass for the season.

Agriculture.

Within a few miles round the city, the cultivation of farms is conducted with a view to the wants of that great market, where potatoes, turnips, and clovers, are found more profitable than corn. The price of these crops, sold on the ground, the purchaser taking upon himself all the expence of carrying them to market, or taking them away for his own consumption, may average about L.20 the Scots acre, (about L.16 the English,) and very fine crops sometimes bring more than L.30. Early potatoes, raised within a mile of the city, have been sold, to the extent of several acres on one farm, at L.50 an acre. The manure for raising these crops is amply supplied by the streets and stables of the city, which sells at 3s. a cubic yard or more, according to its quality and the demand. A few years ago, the street soil was let out to one individual, and brought the city a clear revenue of L.2000 a year. This kind of manure, the effects of which are not so lasting as those of stable or farm-yard dung, enables the farmers to raise large crops of wheat, and other kinds of corn, after the green crops, upon soils that are not naturally very fertile; but the seeds of all sorts with which it abounds are unfavourable to the cleanness of their fields. Their straw, instead of being consumed or converted into manure on their farms, is carried to the city, and sold at a rate averaging from L.3 to L.5 an acre, or sometimes given to stablers in exchange for their dung. The rent of farms, of from 50 to 100 acres, within a mile of the city, is in some instances so high as L.8 or L.10 an acre. Lime is very little employed as a manure within the circle to which the town dung extends. Beyond this circle, the radius of which may be about five miles, the system of cultivation is nearly the same as we have already described under other Scottish counties.

Woods.

The extent of the natural wood has been estimated at 3000 acres, and of plantations about 14,000, together about one acre in every fourteen.

Horticulture.

In 1812, 400 acres were employed in raising vegetables for the city, within a circuit of five miles, and 100 acres more were under strawberries. Mr Neill, Secretary to the Horticultural Society, states the produce of the former at L.45, and the rent from L.8 to L.16 an acre. Between 60,000 and 70,000 Scots pints of strawberries (nearly half as many English gallons) are annually sold in Edinburgh, at from 10s. 6d. a pint down to 9d. The produce of an acre is from 800 to 900 pints, thus yielding a return not very different from the garden grounds. There are also several nurseries in the immediate vicinity of the city, some of them equal to any in the United Kingdom for their collection of fruit and forest trees, shrubs, and herbaceous plants, as well as for the arrangement and keeping of the grounds. About 130 acres are employed in this way.

Manufactures, &c.

The manufactures and commerce of this county, exclusive of Edinburgh, and Leith its sea-port, are inconsiderable. None of the three great branches

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of industry, the woollen, cotton, or linen manufacture, is carried on here to any extent. Distilleries, paper-mills on both branches of the Esk, iron works at Cramond, potteries and salt-pans at Inveresk, and gunpowder works at Temple, on the South Esk, are the most worthy of notice. From the metropolis of Scotland being situated here, the public roads that pass through it in every direction are kept in the best order, and thus promote its internal trade. A system of railways is now in contemplation from the coal works to the south-east of the city, but with a view to their further extension.

Union Canal.

A communication between Edinburgh and Glasgow is now about to be obtained by means of the Union Canal, a work which promises to be of great utility to this county, and the want of which has long been felt. This canal, which is to be five feet deep, and at the surface 37 feet wide, contracting to 22 feet at the bottom, begins at the Lothian Road, on the west of Edinburgh, and, crossing the Water of Leith at Slateford, passes the villages of Ratho, Broxburn, and Winchburgh, and the towns of Linlithgow and Falkirk, and joins the Forth and Clyde Canal at Lock No. 16, near the village of Camelon, after a course of 30 miles. The principal aqueducts are, one over the Water of Leith, at Slateford, 500 feet long and 50 feet high; and another of 12 arches of 50 feet span, over the river Avon, two miles above Linlithgow Bridge, 835 feet long, and 90 feet in height above the bed of the river. Both of these are to be lined with an iron trough instead of puddle. About $28\frac{1}{2}$ miles from Edinburgh, as the line passes Falkirk, there is to be a tunnel through Prospect Hill, a third of a mile in length. There will be nine locks in all on this canal, close together, about a mile west of Falkirk; and to Glasgow from the point of junction, there are four locks more, on the Forth and Clyde Canal; but it is proposed to carry a branch from the Union up to the summit level of the other canal, by which *four* of the Union locks and the four of the Forth and Clyde, will be saved to vessels going directly from Edinburgh to Glasgow, leaving only *five* locks on that passage. The estimate for the Union Canal was L.240,500, which has been raised in shares of L.50 each; and it is not expected that the expence will be more. It was begun at Edinburgh in March 1818, and in March 1819, 14 miles of the 30 were nearly excavated; the whole, it is hoped, may be finished by September 1821. It has been found, on survey, that it may be continued on the same level through East Lothian, by Dalkeith, Haddington, &c. A lockage of 250 feet would carry it down to Leith. One great object of this work is to facilitate the conveyance of coals to the city from the coal-fields near Falkirk.

Villages.

Besides the capital itself, there is no town of any note in Edinburghshire, but a great many thriving villages. Of these may be mentioned, Mid-Calder, Corstorphine, and Cramond, in the north-west; Pennicuik, Dalkeith, Laswade, Loanhead, and Gilmerton, in the east and south, and Musselburgh, including the villages of Inveresk and Fisherrow, Portobello and Newhaven, on the Frith of Forth. Portobello is a pleasant village, lately built, and much resorted to for sea-bathing. Hot and cold baths have been constructed there upon a very elegant plan. Edinburgh is plentifully supplied with fish by the *fish-wives* (as they are called) of Newhaven and Fisherrow, a singularly active and laborious race, and very acute in their dealings, who bring in the fish on their backs in large *creels* or wicker-baskets, and cry them through the streets of the city. Dalkeith, the most populous of the places we have mentioned, has been long distinguished for its great weekly markets for meal and grain. The agreeable and healthy situation of Musselburgh obtained for it of old the name of the *Montpelier* of Scotland.

Principal Seats.

Among the principal seats are, *Dalkeith House*, Duke of Buccleuch; *Newbattle Abbey*, Marquis of Lothian; *Duddingstone*, Marquis of Abercorn; *Dalmahoy*, Earl of Morton; *Dalhousie Castle*, Earl of Dalhousie; *Melville Castle*, Viscount Melville; *Calder House*, Lord Torphichen; *Arniston*, Lord Chief Baron Dundas; *Pennicuik*, Sir George Clerk, member for the county. There is a curious fossil tree on the south bank of the North Esk, in the grounds of Pennicuik, which has lately attracted some notice. A figure of it is given in the new series of the *Scots Magazine* for December 1818. To the above may be added, the names of some other old families, who have long held estates in the county, viz. Baird, Borthwick, Craig, Dalrymple, Dick, Drummond, Foulis, Hope, Inglis, Law, Little, Nesbit, Scott, Trotter, Watson, Wauchope, and Wilkie.

Population.

Edinburghshire sends two members to Parliament, one for the county and another for the city, the only royal burgh in it. The annexed abstract exhibits the state of the population of the county in 1800 and 1811, which there is reason to believe has increased considerably since the last enumeration.—See Robertson's *Survey of Mid-Lothian*—the *Statistical Account of Scotland*—*Beauties of Scotland*, Vol. I.—Sir John Sinclair's *General Report of Scotland*—and for the history and antiquities of the county, Chalmers's *Caledonia*, Vol. II. (A.)

1800.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
17,111	28,186	1081	54,224	68,730	7758	21,036	90,256	122,954

Edinburghshire || Edrisi.

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
15,789	33,043	1167	65,004	83,603	3594	13,254	16,195	148,607

A.

EDRISI, or ALDRISI, the most eminent of the geographers who have written in the Arabic language. There is no individual of equal eminence over whose life there hangs a deeper veil of mystery, the various parts of it affording rather subjects of controversy to the learned than of precise information to the biographer. The place, and even the country in which he was born, compose the first subject of disputation. Sionita and Hezronita, who published a Latin translation of his work at Paris, make him a Nubian, and gave to their work the title of *Geographia Nubiensis;* the "Nubian Geography." They proceeded upon the expression there used, "The Nile of Egypt, which cuts *our* land." Hartmann was at once led to suspect the correctness of this inference by observing that Nubia was one of the countries of which Edrisi gives the most meagre and imperfect account. His suspicions were confirmed by learning that Ockley, on examining two manuscripts in the Bodleian library, had found in both "that land," instead of "*our* land." It seems now generally agreed, therefore, that there is no reason to suppose him of Nubian origin. Others have given him an Egyptian one, which seems more probable, yet rests solely upon the erroneous reading above referred to. In 1663, Bochart stated that he had found, in a manuscript of Leo Africanus, that Edrisi was born at Mazara, in Sicily, in 1098. Next year, however, the manuscript was edited by Hottinger, in an Appendix to his work, entitled *Bibliothecarius Quadripartibus,* when it appeared, that the person supposed to be Edrisi was there named Esseriff Essachalli. Esseriff, or Scheriff, is indeed an usual appellation of Edrisi, but is common to many, and is rather a title than a name. The rest of the name, and the date of birth, are materially different, so that there seems very little reason to doubt that Bochart was here mistaken.

The most positive statement on the subject is that of Casiri, who says (*Bibliotheca Arabico-Hispanica,* II. 9.) that if Edrisi, as appeared probable, were the person designated by the Mahommedan writers under the long appellation of Abu Abdallah Mohamad Ben Mohamad Ben Abdallah Ben Edris, he was born at Septa (Ceuta) on the coast of Morocco, in the year of the Hegira 493 (A. D. 1099). Casiri not only qualifies his statement with this condition, but he does not state the authorities from which it is derived: so that it rests only upon the confidence reposed in his learning and accuracy. Edrisi was long a mighty name in Northern Africa; but, in 919, the dynasty was subverted by Mahedi Abdallah, and the proscribed wrecks of the family, according to D'Herbelot, sought refuge in Sicily. This, certainly, tends to strengthen the Sicilian origin of our author; though it is probable that many would seek refuge by concealment in their native county.

If we may trust the information of Casiri, Edrisi pursued his studies at Cordova, then equally famed as a seat of Moorish empire and a seminary of Arabic learning. From the accurate and particular description he has given of Spain, it is probable that he travelled through a great part of that country. Various circumstances prove that he removed to Sicily, and began to compose his great work under the patronage, and indeed at the express desire, of Roger II. king of that island. It was completed about the year 1153. (Heg. 548.)

It has been a subject of pretty warm controversy among the learned whether Edrisi was a Mahomedan or Christian. Sionita, who adopts the latter opinion, observes that he repeatedly calls our Saviour the Lord Jesus, and on one occasion simply "the Lord," a title which is said never to be applied by Mahometans unless to Mahomet, while they merely say "Jesus, to whom be peace," or "Jesus, to whom be safety." He also speaks with profound respect of the holy Virgin, and of various saints, using, in regard to the latter, the Italian expression instead of the Arabic. These arguments are strenuously repelled by Hartmann, though not, as appears to us, on very solid grounds. He justly remarks, indeed, that the Mahometans speak always with the highest respect of every thing connected with the origin of Christianity. But though this may impair the force of Sionita's arguments, there seems nothing of any importance to place in the opposite scale. Hartmann lays much stress on the circumstance that Edrisi, among his numerous names, bears that of Mahomed, which he says was never born by any Christian; but, though this may imply that he was a Mahometan by birth, it does not authorize us to infer that he may not have become a convert to the opposite faith. He evidently wishes to offend persons of neither profession, and thus writes in a style from which no positive inference can be drawn. But, considering how high religious differences ran in that age, it does not appear very probable that he could have resided in Sicily, or been in such high favour with Roger,

Edrisi.

without adopting the religion of the monarch and country.

The only thing relative to the life of this eminent author which remains even a subject of controversy, is the period of its termination. Bochart has fixed it in the year 1122; but this date clearly proves that he had some quite different person in view; since it appears by the preface to Edrisi's own work, that its completion took place in the year 1153. No other notice, or even conjecture, relative to the time or manner of his death, is to be found in any author.

From these meagre notices respecting the life of Edrisi, we shall proceed to give some account of his work. It has appeared under various titles. The first and fullest appears to have been, *The going out of a Curious Man to explore the Regions of the Globe, its Provinces, Islands, Cities, and their Dimensions and Situation.* This is sometimes abbreviated into *The going out of a Curious Man to explore the Regions of the Globe;* and sometimes merely *The Going out of a Curious Man.* Sionita published it under the name of *Relaxation of the Curious Mind;* but the title of *Nubian Geography*, which he and his companion imposed upon it, though it has become general in Europe, is, as is already observed, altogether arbitrary.

The work contains a full description of the whole world, so far as known to the author, with its countries, cities, and all its features, physical and political. These are arranged, not according to any of the methods to which we are accustomed, but in a manner peculiar to itself. The world is divided into seven *climates*, commencing at the equinoctial line, and extending northwards to the limit at which the earth is supposed to be rendered uninhabitable by cold. Each climate is then divided, by perpendicular lines, into eleven equal parts, beginning with the western coast of Africa, and ending with the eastern coast of Asia. The whole world is thus formed into seventy-seven equal square compartments, resembling those upon a chess-board, or those formed upon a plane map, by the intersecting lines of latitude and longitude. The geographer begins with the first part of the first climate, including the western part of central Africa, and proceeds eastward through the different divisions of this climate, till he finds its termination in the sea of China. He then returns to the first part of the second climate, and so proceeds till he reaches the eleventh part of the seventh climate, which terminates in the north-eastern extremity of Asia. The inconveniences of such an arrangement must be abundantly obvious. Instead of each country, or at least each region of similar physical character, being described by itself, it is severed, by these mechanical sections, into fragments, which are described in different and distant parts of the work; and no connected view is given of any great country.

In drawing the general outlines of cosmography, Edrisi describes the earth as globular; that figure being only interrupted by the varieties of mountains and valleys on its surface. He adheres to the doctrine of those ancient schools, which supposed an uninhabited torrid zone; but, as his knowledge extended to populous countries south of the tropic, he placed the commencement of this zone, with very little propriety, at the equinoctial line: beyond this he says there are neither plants nor animals, all being uninhabitable on account of the heat. Again, the habitable world extends only to the 64th degree of north latitude, beyond which all is frozen with ice and perpetual winter. The circumference of the earth he estimates at 132,000,000 cubits, or 11,000 leagues. He mentions also a measurement by Hermes, which made it 36,000 miles. He divides the whole, according to the established system, into 360 degrees; observing, however, that in consequence of the impossibility of passing the equinoctial line, the known world consists only of one hemisphere: of this one half is land, and the other sea, which last consists chiefly of the great ambient sea, surrounding the earth in a continued circuit, like a zone, and in which "the earth floats like an egg in a bason of water." The only portion of it concerning which much was known was the Atlantic Ocean, called the "Sea of Darkness;" the mind, by a natural process, transferring the obscurity of its own ideas to the object on which they were exercised. That still less known part which rolled along the north-eastern extremity of Asia was, from the same principle, called the "Sea of Pitchy Darkness." Besides this great sea, Edrisi reckons seven smaller ones,—the Indian Sea; the Red Sea, or Arabian Gulf; the Green Sea, or the Persian Gulf; the Sea of Damascus, or the Mediterranean; the Sea of the Venetians, or the Adriatic; the Sea of Pontus, or the Black Sea; the Sea of Georgian, or Dailem, by which he means the Caspian.

The countries best known to Edrisi are those of Northern Africa, Spain, and Arabia, which are described with minute topographical exactness. As we possess accounts of them, however, equally detailed, and more recent, the chief value is attached to that part of his work where he treats of the interior parts of Africa; regions into which, notwithstanding immense efforts, no European traveller has yet been able to penetrate. In consequence of the colonies and settlements formed there by several Arabian dynasties, Edrisi possessed opportunities of information, of which religious estrangement has deprived Christian Europe. His description, however, cannot be considered as throughout correct; or rather, it is so only for a certain space; after which it deviates into the realms of imagination and conjecture. The leading feature delineated by him is that of the great central river, called the *Nile of the Negroes*, the Niger of Ptolemy and of the moderns, which he represents to rise from the same fountain as the Egyptian Nile, and to flow westwards till it falls into the sea. This statement has not been confirmed by modern discovery, but it is doubtful how far the moderns may not have erred as to the regions designated by Edrisi, and even the precise import of the terms employed by him. From him, however, have been delineated, in all our modern maps, Wangara, surrounded by the branches of the Niger, which form in it two large lakes; with the cities of Gana, Tocrur, Berissa, and Sala, situated along its banks. The eastern coast of Africa is described accurately as to the countries contained in

Edrisi.

it, but with a singular error of direction, being made to run from west to east, parallel to the southern coast of Asia. The idea was probably suggested by the great unknown continent of Ptolemy, which was made to follow the same direction; and it was rendered almost necessary by our author's hypothesis, that no country could be habitable to the south of the line; since such an extent of coast produced in a southerly direction must necessarily have passed that limit. Thus, however, Sofala is placed upon the sea of China, while Madagascar, under the name of Al Comr, or the Island of the Moon, forms part of the oriental archipelago. In Asia, Edrisi shows considerable acquaintance with the central and southern regions, though he has not described them so fully as Abulfeda and other writers, who resided in Syria and Bagdad. The northern part is occupied by the fabulous abodes of Yagiouje and Magiouje, or Gog and Magog. Their territories were defended by a tremendous castle or rampart of iron, the idea of which was probably derived from some fortified pass in the mountains which stretch across central Asia.

In Europe, with the exception of Spain and Sicily, the information of Edrisi is neither accurate nor extensive. Germany is particularly ill delineated; England he describes as a great island, in its form resembling an ostrich, in which are seen " cities, lofty mountains, flowing rivers, and a level land, but where perpetual winter reigns." He names its capital and principal sea-ports. To the north is the *island* of Scotland, some features of which he mentions, though in a manner difficult to identify. He mentions also Ireland, and appears even to have a faint knowledge of Orkney and Shetland.

The only valuable unpublished manuscripts of Edrisi which now exist in Europe, are two that are preserved in the Bodleian Library. The first, which was brought over by Greaves from Egypt, is written in the Arabic character peculiar to northern Africa. It is illustrated by a map of the known world, and by thirty-three maps, containing each part of a climate, so that there are maps only for the three first climates. The second manuscript, brought by Pococke from Syria, is written in the Arabic character, as used in that country, and bears the date of 906, Heg. (A. D. 1500). It consists of 320 leaves, and is illustrated by one general and seventy-seven particular maps, the last consequently including all the parts of every climate. The general map has been published by Dr Vincent in his *Periplus of the Egyptian Sea.* The writer of this article has examined these maps, and found them to throw considerable light upon the geographical system adopted by the Arabian writers.

There is a manuscript (Cod. DLXXX) in the Royal Library at Paris, which professes to be the production of Edrisi; but D'Herbelot, it appears, has not made use of it as such; and De Guignes expresses positive disbelief on the subject. Hartmann, however, found it to coincide, in many particulars, with the geography of Edrisi. A copy of our author's work was contained, at one time, in the library of the Escurial, but it was destroyed by a great fire in 1671.

The geography of Edrisi, in the original Arabic, was printed at Rome in 1592, at the Medicean press, from a manuscript preserved in the Grand-ducal library at Florence. Both the paper and printing are exceedingly neat; the latter being made to resemble manuscript. This unfortunately constitutes the whole merit of the edition, which swarms with typographical errors, and forms, besides, only an epitome of the original work. This epitome seems made, indeed, in the oriental style, by the simple omission of those parts which appeared to the editor to be superfluous; but these comprise many essential and important passages. The description of Mecca, for example, which had been unaccountably omitted, is supplied by Pococke from his manuscript. Hartmann gives instances, where reference is made to the description of places of which there occurs no other mention. D'Herbelot and Casiri equally remark the imperfections of this edition; and the information obtained by the writer of this article at Oxford as to the result of a comparison between it and the manuscripts in that university, tends entirely to confirm their statements. In most bibliographical works, this impression has been characterized as one of the rarest of books; but Adler, in a visit to Florence, found, in the palace there, 1129 copies, which were publicly exposed to sale at a moderate rate. If, therefore, the book be wanting, even in many extensive public libraries, it is merely because those libraries have not taken the trouble to procure it.

In 1619, two oriental scholars, Gabriel Sionita and John Hezronita, published at Paris a Latin translation of Edrisi's work, bearing the title, as already observed, of *Geographia Nubiensis.* It is not executed with all that care and accuracy which might have been expected from these learned personages. They have been particularly careless as to the proper names, which are given sometimes in Latin, sometimes in Arabic, sometimes in neither, nor in any intelligible language. In consequence of the Arabic original being occasionally appended, it has been supposed to have been reprinted along with it; but this is a mistake, there being no edition ever printed except the Roman one. George Hieronymus Velschius, an eminent German scholar, had prepared a copy of the Arabic original, with a Latin translation, which he intended to have illustrated with notes; but death prevented the execution of this design; and his manuscript remains deposited in the library of the University of Jena. Casiri (*Bibliotheca Arab. Hispan.* II. 13.) mentions that, at the request of many friends, he had determined to re-edit this work, but he never appears to have executed this intention. The part relating to Africa, pre-eminent, certainly, in point of importance, has been very ably edited by Hartmann, Professor of Oriental Languages at Marburg (Edrisi, *Africa,* Gottingen, 1796). Instead of following the awkward division into climates, he has collected together all the notices relating to each particular country; and has annexed the statements of the countrymen and contemporaries of Edrisi, so that his work forms nearly a complete body of Arabian geography, so far as relates to Africa. It does not appear, however, that he had an opportunity of consulting the

Oxford manuscripts, or any others of importance, by which the deficiencies of the printed edition could be supplied. A complete edition of this work is, therefore, still wanting; and the learned world may naturally expect it from the University of Oxford, which possesses, in Mr Nicol, Junior Librarian of the Bodleian, a scholar well qualified for the task, and who promises to support the long-established fame of the University in oriental literature. (B.)

EDUCATION.

The end of education is to render the individual, as much as possible, an instrument of happiness, first to himself, and next to other beings.

The properties, by which he is fitted to become an instrument to this end, are, partly, those of the body, and, partly, those of the mind.

Happiness depends upon the condition of the Body, either immediately, as where the bodily powers are exerted for the attainment of some good; or mediately, through the mind, as where the condition of the body affects the qualities of the mind.

Education, in the sense in which it is usually taken, and in which it shall here be used, denotes the means which may be employed to render the *mind*, as far as possible, an operative cause of happiness. The mode in which the *body* may be rendered the most fit for operating as an instrument of happiness is generally considered as a different species of inquiry, and is thought to belong to physicians and others, who study the means of perfecting the bodily powers.

Definition.

Education, then, in the sense in which we are now receiving it, may be defined, the best employment of all the means which can be made use of, by man, for rendering the human mind to the greatest possible degree the cause of human happiness. Every thing, therefore, which operates, from the first germ of existence, to the final extinction of life, in such a manner as to affect those qualities of the mind on which happiness in any degree depends, comes within the scope of the present inquiry. The grand question of education embraces nothing less than this—namely, What can be done by the human powers, by aid of all the means which are at human disposal, to render the human mind the instrument of the greatest degree of happiness? It is evident, therefore, that nothing, of any kind, which operates at any period of life, however early, or however late, ought to be left out of the account. Happiness is too precious an effect, to let any cause of it, however small, run to waste and be lost. The means of human happiness are not so numerous that any of them can be spared. Not to turn every thing to account, is here, if any where, bad economy, in the most emphatical sense of the phrase.

Objects of this Article.

The field, it will easily be seen, is exceedingly comprehensive. It is everywhere, among enlightened men, a subject of the deepest complaint, that the business of education is ill performed; and that, in this, which might have been supposed the most interesting of all human concerns, the practical proceedings remain far behind the actual state of the human mind. It may be remarked, that, notwithstanding all that has been written on the subject, even the *theory* of education has not kept pace with the progress of philosophy; and it is unhappily true, that the *practice* remains to a prodigious distance behind the theory. One reason why the theory, or the combination of ideas which the present state of knowledge might afford for improving the business of education, remains so imperfect, probably is, that the writers have taken but a partial view of the subject; in other words, the greater number have mistaken a part of it for the whole. And another reason of not less importance is, that they have generally contented themselves with vague ideas of the object or end to which education is only useful as means. One grand purpose of the present inquiry will be to obviate all these mistakes; and, if not to exhibit that comprehensive view, which we think is desirable, but to which our limits are wholly inadequate; at any rate, to conduct the reader into that train of thought which will lead him to observe for himself the ultimate boundaries of the field; and, conceiving more accurately the end, to form a better estimate of what is desirable as the means.

Division of these objects.

1. It has been remarked, that every thing, from the first germ of existence to the final extinction of life, which operates in such a manner as to affect those qualities of the mind on which happiness in any degree depends, comes within the scope of the present inquiry. Those circumstances may be all, according to the hackneyed division, arranged under two heads: They are either Physical or Moral; meaning by Physical, those of a material nature, which operate more immediately upon the material part of the frame; by Moral, those of a mental nature, which operate more immediately upon the mental part of the frame. What are those physical and moral circumstances which may be made to operate upon the mind in such a manner as to render it a better instrument or cause of happiness, is, therefore, one object of the present inquiry.

2. In order to know in what manner things operate upon the mind, it is necessary to know how the mind is constructed. *Quicquid recipitur, recipitur ad modum recipientis.* This is the old aphorism, and no where more applicable than to the present case. If you attempt to act upon the mind, in ways not adapted to its nature, the least evil you incur is to lose your labour.

3. As happiness is the end, and the means ought to be nicely adapted to the end, it is necessary to inquire, What are the qualities of mind which chiefly conduce to happiness,—both the happiness of the individual himself, and the happiness of his fellow creatures?

It appears to us, that this distribution includes the whole of the subject. Each of these divisions

Education. branches itself out into a great number of inquiries. And, it is manifest, that the complete developement of any one of them would require a greater space than we can allow for the whole. It is, therefore, necessary for us, if we aim at a comprehensive view, to confine ourselves to a skeleton; and this we think is both the most instructive course we can pursue, and the best adapted to the nature of the work for which it is designed.

Order of inquiry. The next question is, Which of these three divisions of the inquiry it will be most advantageous to the developement of the subject to begin with. The first, it is evident, is the most practical, and, therefore, likely to be the most interesting. Under the Physical Head, it includes inquiries into the mode in which the qualities of the mind are affected by the health, the aliment, the air, the labour, &c. to which the individual is subject. Under the Moral Head it includes inquiries into what may be called, 1. Domestic education, or the mode in which the mind of the individual is liable to be formed by the conduct of the individuals composing the family in which he is born and bred: 2. Technical or scholastic education, including all those exercises upon which the individual is put, as means to the acquisition of habits,—habits either conducive to intellectual and moral excellence, or even to the practice of the manual arts: 3. Social education, or the mode in which the mind of the individual is liable to be affected by the conduct of the men who form the society in which he moves: 4. Political education, or the mode in which the mind of the individual is acted upon by the nature of the political institutions under which he lives.

The two latter divisions comprehend what is more purely theoretical; and the discussion of them will, therefore, have fewer attractions to that class of readers, unhappily numerous, to whom intellectual exercises have not by habit been rendered delightful. To the inquiries, however, which are included under the first division, it appears, that those included under the two last are required as a foundation. The fact is, that good practice can, in no case, have any solid foundation but in sound theory. This is not more important, than it is demonstrable and certain. For, What is theory? It is the putting the *whole* of the knowledge, which we possess upon any subject, into that order and form in which it is most easy to draw from it good practical rules. Let any one examine this definition, article by article, and show us that it fails in a single particular. If it does not, let us no longer hear of the separation of theory from practice.

Nature of the Mind, as connected with Education. 1. The first, then, of the inquiries, embraced by the great subject of education, is that which regards the nature of the human mind; and the business is, agreeably to the foregoing definition of theory, to put the knowledge which we possess respecting the human mind, into that order and form, which is most advantageous for drawing from it the practical rules of education. The question is, How the mind, with those properties which it possesses, can, through the operation of certain means, be rendered most conducive to a certain end? To answer this question, the whole of its properties must be known. The whole science of human nature is, therefore, but a branch of the science of education. Nor can education assume its most perfect form, till the science of the human mind has reached its highest point of improvement. Even an outline, however, of the philosophy of the human mind would exceed the proportion of the present article; we must, therefore, show what ought to be done, rather than attempt, in any degree, to execute so extensive a project.

With respect to the human mind, as with respect to every thing else, all that passes with us, under the name of knowledge, is either matter of experience, or, to carry on the analogy of expression, matter of guess. The first is real knowledge; the properties of the object correspond to it. The latter is suppositious knowledge, and the properties of the object do or do not correspond to it; most likely not. The first thing desirable is, to make an exact separation of those two kinds of knowledge; and, as much as possible, to confine ourselves to the first.

What, then, is it which we experience with regard to the human mind? and what is it which we guess? We have experience of ourselves, when we *see*, when we *hear*, when we *taste*, when we *imagine*, when we *fear*, when we *love*, when we *desire;* and so on. And we give names, as above, to distinguish what we experience of ourselves, on one of those occasions, from what we experience on another. We have experience of other men exhibiting *signs* of having similar experiences of themselves, that is, of *seeing*, *hearing*, and so on. It is necessary to explain, shortly, what is here meant by a sign. When we ourselves *see*, *hear*, *imagine*, &c. certain actions of ours commonly follow. We know, accordingly, that if any one, observing those actions, were to infer that we had been *seeing*, *hearing*, &c., the inference would be just. As often then as we observe similar actions in other men, we infer that they, too, have been seeing or hearing; and we thus regard the action as the sign.

Having got names to distinguish the state or experience of ourselves, when we say, *I see*, *I hear*, *I wish*, and so on; we find occasion for a name which will distinguish the having of any (be it what it may) of those experiences, from the being altogether without them; and, for this purpose, we say, *I feel*, which will apply, generally, to any of the cases in which we say, I *see*, or *hear*, or *remember*, or *fear;* and comprehends the meaning of them all. The term *I think*, is commonly used for a purpose nearly the same. But it is not quite so comprehensive. There are several things which we should undoubtedly include under the term *our experience of our mind*, to which we should not extend the term *I think*. But there is nothing whatsoever included under it to which we should not extend the term *I feel;* this is truly, therefore, the generic term.

All our experience, then, of the human mind, is confined to the several occasions on which the term *I feel* can be applied. And, now, What does all this experience amount to? What is the knowledge which it affords? It is, first, a knowledge of the *feelings* themselves; we can remember what,

one by one, they were. It is, next, a knowledge of the order in which they follow one another; and this is all. But this description, though a just one, is so very general as to be little instructive. It is not easy, however, to speak about those feelings minutely and correctly; because the language which we must apply to them is ill adapted to the purpose.

Let us advert to the first branch of that knowledge, the knowledge of the feelings themselves. This, in the simple cases, may be regarded as easy; the feeling is distinct at the moment of experience, and is distinctly remembered afterwards. But the difficulty is great with the complex cases. It is found, that a great number of simple feelings are apt to become so closely united, as often to assume the appearance of only one feeling, and to render it extremely difficult to distinguish from one another the simple feelings of which it is composed. And one of the grand questions which divide the mental philosophers of the present day, is to determine which feelings are simple and which are complex. There are two sorts which have, by all, been regarded as simple: Those which we have when we say, I hear, I see, I feel, I taste, I smell, corresponding to the five senses, and which Mr Hume distinguished by the name of *impressions;* and the feelings corresponding to these impressions, which Mr Hume calls *ideas* of them; the second taking place only in consequence of the first, and being, as it were, a revival of them; not the same feelings with the impressions, by any means; but feelings which bear a certain resemblance to them. Thus, when a man sees the light of noon, the feeling he has is called an *impression,*—the impression of light; when he shuts his eyes and has a feeling,—the type or relict of the impression,—he is not said to *see* the light, or to have the *impression* of light, but to *conceive* the light, or have an *idea* of it.

These two,—*impressions,* and their correspondent *ideas,*—are simple feelings, in the opinion of all philosophers. But there is one set of philosophers who think that these are the only simple feelings, and that all the rest are merely combinations of them. There is another class of philosophers who think that there are original feelings beside impressions and ideas; as those which correspond to the words *remember, believe, judge, space, time,* &c. Of the first are Hartley and his followers in England, Condillac and his followers in France; of the second description are Dr Reid and his followers in this country, Kant and the German school of metaphysicians in general on the Continent.

It is evident, that the determination of this question with regard to the first branch of knowledge, namely, what the feelings are? is of very great importance with regard to the second branch of knowledge, namely, what is the order in which those feelings succeed one another? For how can it be known how they succeed one another, if we are ignorant which of them enter into those several groups which form the component parts of the train? It is of vast importance, then, for the business of education, that the analysis of mind should be accurately performed; in other words, that all our complex feelings should be accurately resolved into the simple ones of which they are composed. This, too, is of absolute necessity for the accurate use of language; as the greater number of words are employed to denote those groups of simple feelings which we call complex ideas.

In regard to all the events in this world, of which feelings are a class, our knowledge extends not beyond two points. The first is, a knowledge of the events themselves; the second is, a knowledge of the order of their succession. The expression in words of the first kind of knowledge is history; the expression of the second is philosophy; and to render that expression short and clear is the ultimate aim of philosophy.

The first steps in ascertaining the order of succession among events are familiar and easy. One occurs, and then another, and after that a third, and so on; but at first it is uncertain whether this order is not merely accidental, and such as may never recur. After a time it is observed, that events, similar to those which have already occurred, are occurring again and again. It is next observed, that they are always followed, too, by the same sort of events by which those events were followed to which they are similar; that these second events are followed, in the third place, by events exactly similar to those which followed the events which they resemble; and that there is, thus, an endless round of the same sequences.

If the order in which one event follows another were always different, we would know events only one by one, and they would be infinitely too numerous to receive names. If we could observe none but very short sequences, if, for example, we could ascertain that one event was, indeed, always followed by one other of the same description, but could not trace any constancy farther, we should thus know events by sequences of twos and twos. But those sequences would also be a great deal too numerous to receive names.

The history of the human mind informs us, that the sequences which men first observe are but short ones. They are still, therefore, too numerous to receive names. But men compound the matter. They give names to those sequences which they are most interested in observing, and leave the rest unnamed. They then, when they have occasion to speak of the unnamed successions, apply to them, the best way they can, the names which they have got; endeavouring to make a partial naming answer an universal purpose, and hence almost all the confusion of language and of thought arises.

The great object is, then, to ascertain sequences more and more extensive, till, at last, the succession of all events may be reduced to a number of sequences sufficiently small for each of them to receive a name; and then, and then only, shall we be able to speak wholly free from confusion.

Language affords an instructive example of this mode of ascertaining sequences. In language, the words are the events. When an ignorant man first hears another speak an unknown language, he hears the sounds one by one, but observes no sequence. At last he gathers a knowledge of the use of a few

words, and then he has observed a few sequences; and so he goes on till he understands whatever he hears. The sequences, however, which he has observed, are of no greater extent than is necessary to understand the meaning of the speaker; they are, by consequence, very numerous and confusing.

Next comes the grammarian; and he, by dividing the words into different kinds, observes that these kinds follow one another in a certain order, and thus ascertains more enlarged sequences, which, by consequence, reduces their number.

Nor is this all; it is afterwards observed, that words consist, some of one syllable, and some of more than one; that all language may thus be resolved into syllables, and that syllables are much less in number than words; that, therefore, the number of sequences in which they can be formed are less in number, and, by consequence, are more extensive. This is another step in tracing to the most comprehensive sequences the order of succession in that class of events wherein language consists.

It is afterwards observed, that these syllables themselves are compounded; and it is at last found, that they may all be resolved into a small number of elementary sounds corresponding to the simple letters. All language is then found to consist of a limited number of sequences, made up of the different combinations of a few letters.

It is not pretended that the example of language is exactly parallel to the case which it is brought to illustrate. It is sufficient if it aids the reader in seizing the idea meant to be conveyed. It presents, at any rate, a striking analogy between the analysing of a complex sound, namely, a word, into the simple sounds of which it is composed, to wit, letters; and the analysing of a complex feeling, such as the idea of a rose, into the simple feelings of sight, of touch, of taste, of smell, of which the complex idea or feeling is made up. It affords, also, a brilliant proof of the commanding knowledge which is attained of a train of events, by observing the sequences which are formed of the simplest elements into which they can be resolved; and it thus illustrates the two grand operations, by successful perseverance in which the knowledge of the human mind is to be perfected.

It is upon a knowledge of the sequences which take place in the human feelings or thoughts, that the structure of education must be reared. And, though much undoubtedly remains to be cleared up, enough is already known of those sequences to disgrace the education with which our supineness, and love of things as they are, rest perfectly satisfied.

As the happiness, which is the end of education, depends upon the actions of the individual, and as all the actions of man are produced by his feelings or thoughts, the business of education is, to make certain feelings or thoughts take place instead of others. The business of education, then, is to work upon the mental successions. As the sequences among the letters or simple elements of speech, may be made to assume all the differences between nonsense and the most sublime philosophy, so the sequences, in the feelings which constitute human thought, may assume all the differences between the extremes of madness and of wickedness, and the greatest attainable heights of wisdom and virtue; and almost the whole of this is the effect of education. That, at least, all the difference which exists between classes or bodies of men is the effect of education, without entering into the dispute about individual distinctions, we suppose, will be readily granted; that it is education wholly which constitutes the remarkable difference between the Turk and the Englishman, and even the still more remarkable difference between the most cultivated European and the wildest savage. Whatever is made of any *class* of men, we may then be sure is possible to be made of the whole human race. What a field for exertion! What a prize to be won!

Mr Hobbes, who saw so much farther into the texture of human thought than all who had gone before him, was the first man, as far as we remember, who pointed out what is peculiarly *knowledge*, in this respect (namely, the order in which our feelings succeed one another)—as a distinct object of study. He marked, with sufficient clearness, the existence and cause of the sequences; but, after a very slight attempt to trace them, he diverged to other inquiries, which had this but indirectly for their object.

"The succession," he says (*Human Nature*, ch. iv.), "of conceptions in the mind, series or consequence (by *consequence* he means *sequence*) of one after another, may be casual and incoherent, as in dreams, for the most part; and it may be orderly, as when the former thought introduceth the latter. The cause of the coherence or consequence (*sequence*) of one conception to another, is their first coherence or consequence at that time when they are produced by sense; as, for example, from St Andrew the mind runneth to St Peter, because their names are read together; from St Peter to a stone, for the same cause; from stone to foundation, because we see them together; and, according to this example, the mind may run almost from any thing to any thing. But, as in the sense, the conception of cause and effect may succeed one another, so may they, *after* sense, in the imagination." By the succession in the *imagination* it is evident he means the succession of *ideas*, as by the succession in *sense*, he means the succession of impressions.

Having said that the conceptions of *cause* and *effect* may succeed one another in the sense, and after sense in the imagination, he adds, "And, for the most part, they do so; the cause whereof is the appetite of them who, having a conception of the *end*, have next unto it a conception of the next *means* to that end; as when a man from a thought of honour, to which he hath an appetite, cometh to the thought of wisdom, which is the next means thereunto; and from thence to the thought of study, which is the next means to wisdom." (Ib.) Here is a declaration with respect to three grand laws in the sequence of our thoughts. The first is, that the succession of ideas follows the same order which takes place in that of the impressions. The second is, that the order of cause and effect is the most common order in the successions in the imagination,

that is, in the succession of ideas. And the third is, that the appetites of individuals have a great power over the successions of ideas; as the thought of the object which the individual desires leads him to the thought of that by which he may attain it.

Mr Locke took notice of the sequence in the train of ideas, or the order in which they follow one another, only for a particular purpose,—to explain the intellectual singularities which distinguish particular men. "Some of our ideas," he says, "have a natural correspondence and connection one with another. It is the office and excellence of our reason to trace these, and hold them together in that union and correspondence which is founded in their peculiar beings. Besides this, there is another connection of ideas, wholly owing to chance or custom; ideas that are not at all of kin come to be so united in some men's minds, that it is very hard to separate them; they always keep in company, and the one no sooner at any time comes into the understanding, but its associate appears with it; and, if they are more than two which are thus united, the whole gang, always inseparable, show themselves together." There is no attempt here to trace the order of sequence, or to ascertain which antecedents are followed by which consequents; and the accidental, rather than the more general phenomena, are those which seem particularly to have struck his attention. He gave, however, a name to the matter of fact. When one idea is regularly followed by another, he called this constancy of conjunction *the association of the ideas;* and this is the name by which, since the time of Locke, it has been commonly distinguished.

Mr Hume perceived, much more distinctly than any of the philosophers who had gone before him, that to philosophize concerning the human mind was to trace the order of succession among the elementary feelings of the man. He pointed out three great laws or comprehensive sequences, which he thought included the whole. Ideas followed one another, he said, according to *resemblance, contiguity* in time or place, and *cause and effect.* The last of these, the sequence according to cause and effect, was very distinctly conceived, and even the cause of it explained, by Mr Hobbes. That of contiguity in time and place is thus satisfactorily explained by Mr Hume. "It is evident," he says, "that as the senses, in changing their objects, are necessitated to change them regularly, and take them as they lie contiguous to each other, the imagination must, by long custom, acquire the same method of thinking, and run along the parts of space and time in conceiving its objects." (*Treatise of Human Nature,* P. 1. B. 1. sect. 4.) This is a reference to one of the laws pointed out by Hobbes, namely, that the order of succession among the ideas follows the order that took place among the impressions. Mr Hume shows that the order of sense is much governed by contiguity, and why; and assigns this as a sufficient reason of the order which takes place in the imagination. Of the next sequence, that according to resemblance, he gives no account, and only appeals to the consciousness of his reader for the existence of the fact. Mr Hume farther remarked, that what are called our complex ideas, are only a particular class of cases belonging to the same law, the law of the succession of ideas; every complex idea being only a certain number of simple ideas, which succeed each other so rapidly, as not to be separately distinguishable without an effort of thought. This was a great discovery; but it must at the same time be owned, that it was very imperfectly developed by Mr Hume. That philosopher proceeded, by aid of these principles, to account for the various phenomena of the human mind. But though he made some brilliant developements, it is nevertheless true, that he did not advance very far in the general object. He was misled by the pursuit of a few surprising and paradoxical results, and when he had arrived at them he stopped.

After him, and at a short interval, appeared two philosophers, who were more sober-minded, and had better aims. These were Condillac and Hartley. The first work of Condillac appeared some years before the publication of that of Hartley; but the whole of Hartley's train of thought has so much the air of being his own, that there is abundant reason to believe the speculations of both philosophers equally original. They both began upon the ground that all simple ideas are copies of impressions; that all complex ideas are only simple ideas united by the principle of association. They proceeded to examine all the phenomena of the human mind, and were of opinion that the principle of association, or the succession of one simple idea after another, according to certain laws, accounts for the whole; that these laws might, by meditation, be ascertained and applied; and that then the human mind would be understood, as far as man has the means of knowing it.

The merit of Condillac is very great. It may yet, perhaps, be truer to say, that he wrote admirably upon philosophy, than that he was a great philosopher. His power consists in expression; he conveys metaphysical ideas with a union of brevity and clearness which never has been surpassed. But though he professed rather to deliver the opinions of others, than to aim at invention, it cannot be denied that he left the science of the human mind in a much better state than he found it; and this is equivalent to discovery. As a teacher, in giving, in this field, a right turn to the speculations of his countrymen, his value is beyond all calculation; and perhaps there is no one human being, with the exception of Locke, who was his master, to whom, in this respect, the progress of the human mind is so largely indebted. It is also true, that to form the conception of tracing the sequences among our simple ideas, as the whole of the philosophy of the human mind—(even with the helps which Hume had afforded, and it is more than probable that neither Condillac nor Hartley had ever heard of a work which, according to its author, had fallen dead-born from the press),—was philosophical and sagacious in the highest degree.

It must, however, be allowed, that, in expounding the various mental phenomena of man, Condillac does not display the same penetration and force of mind, nor the same comprehensiveness, as Dr Hartley. He made great *progress* in showing how

those phenomena might be resolved into the sequences of simple ideas; but Dr Hartley made still greater. We do not mean to pronounce a positive opinion either for or against the grand undertaking of Dr Hartley, to resolve the whole of the mental phenomena of man into sequences of impressions and of the simple ideas which copy them. But we have no hesitation in saying, that he philosophizes with extraordinary power and sagacity; and it is astonishing how many of the mental phenomena he has clearly resolved; how little, in truth, he has left about which any doubt can remain.

We cannot afford to pursue this subject any farther. This much is ascertained, that the character of the human mind consists in the sequences of its ideas; that the object of education, therefore, is, to provide for the constant production of certain sequences, rather than others; that we cannot be sure of adopting the best means to that end, unless we have the greatest knowledge of the sequences themselves.

In what has been already ascertained on this subject, we have seen that there are two things which have a wonderful power over those sequences. They are, custom, and pain or pleasure. Both of these powers were well remarked by Mr Hobbes. These are the grand instruments or powers, by the use of which, the purposes of education are to be attained.

Where one idea has followed another a certain number of times, the appearance of the first in the mind is sure to be followed by that of the second, and so on. One of the grand points, then, in the study of education, is, to find the means of making, in the most perfect manner, those repetitions on which the beneficial sequences depend.

When we speak of making one idea follow another, and always that which makes part of a good train, instead of one that makes part of a bad train, there is one difficulty—in this—that each idea, taken singly by itself, is as fit to be a part of a bad train as of a good one; for bad trains and good trains are both made out of the same simple elements. Trains, however, take place by sequences of twos, or threes, or any greater number; and the nature of these sequences, as complex parts of a still greater whole, is that which renders the train either salutary or hurtful. Custom is, therefore, to be directed to two points; first, to form those sequences which make the component parts of a good train; and secondly, to join those sequences together, so as to constitute the train.

When we speak of making one idea follow another, there must always be a starting point; there must be some one idea from which the train begins to flow; and it is pretty evident that much will depend upon this idea. One grand question, then, is—what are the ideas which most frequently operate as the commencement of trains?—that we may by custom attach to them such as are the most beneficent. It has been observed that most, if not all, of our trains, start from a sensation, or some impression upon the external or internal nerves. The question then is, which are those sensations, or aggregates of sensations, which are of the most frequent recurrence? it being obviously of importance, that those which give occasion to the greatest number of trains, should be made, if possible, to give occasion only to the best trains. Now the sensations, or aggregates of sensations, which occur in the ordinary business of life, are those of most frequent recurrence; and from which it is of the greatest importance that beneficial trains should commence. Rising up in the morning, and going to bed at night, are aggregates of this description, common to all mankind; so are the commencement and termination of meals. The practical sagacity of priests, even in the rudest ages of the world, perceived the importance, for giving religious trains an ascendancy in the mind, of uniting them, by early and steady custom, with those perpetually recurring sensations. The morning and evening prayers, the grace before and after meals, have something correspondent to them in the religion of perhaps all nations.

It may appear, even from these few reflections and illustrations, that, if the sensations, which are most apt to give commencement to trains of ideas, are skilfully selected, and the trains which lead most surely to the happiness, first of the individual himself, and next of his fellow-creatures, are by custom effectually united with them, a provision of unspeakable importance is made for the happiness of the race.

Beside custom, it was remarked by Hobbes, that appetite had a great power over the mental trains. But appetite is the feeling toward pleasure or pain in prospect; that is, future pleasure or pain. To say that appetite, therefore, has power over the mental trains, is to say, that the prospect of pleasure or pain has. That this is true, every man knows by his own experience. The best means, then, of applying the prospect of pleasure and pain to render beneficent trains perpetual in the mind, is the thing to be found out, and made familiar to mankind.

The mode in which pleasure and pain affect the trains of the mind is, as ends. That is to say; as a train commences, we have supposed, in some present sensation, so it may be conceived as terminating in the idea of some future pleasure or pain. The intermediate ideas, between the commencement and the end, may be either of the beneficent description or the hurtful. Suppose the sight of a fine equipage to be the commencement; and the riches, which afford it, the appetite, or end, of a train in the mind of two individuals at the same time. The intermediate ideas in the mind of the one are beneficent, in the other hurtful. The mind of the one immediately runs over all the honourable and useful modes of acquiring riches—the acquisition of the most rare and useful qualities—the eager watch of all the best opportunities of bringing them into action—and the steady industry with which they may be applied. That of the other recurs to none but the vicious modes of acquiring riches—by lucky accidents—the arts of the adventurer and impostor—by rapine and plunder, perhaps on the largest scale, by all the honours and glories of war. Suppose the one of these trains to be habitual among individuals, the other not. What a difference for mankind!

It is unnecessary to adduce farther instances for

the elucidation of this part of our mental constitution. What, in this portion of the field, requires to be done for the science of education, appears to be, to ascertain, first, what are the ends of human desire, the really ultimate objects at which it points; next, to ascertain what are the most beneficent means of attaining those objects; and lastly, to accustom the mind to fill up the intermediate space between the present sensation and the ultimate object, with nothing but the ideas of those beneficent means. We are perfectly aware that these instructions are far too general. But we hope it will be carried in mind how little, beyond the most general ideas, so confined a sketch as the present can possibly embrace; and we are still not without an expectation that these expositions, general as they are, will not be wholly without their use.

Of the qualities conducive to Happiness.

II. We come now to the second branch of the science of education, or the inquiry what are the qualities with which it is of most importance that the mind of the individual should be endowed. This inquiry we are in hopes the preceding exposition will enable us very materially to abridge. In one sense, it might undoubtedly be affirmed, that all the desirable qualities of the human mind are included in those beneficent sequences of which we have spoken above. But, as it would require, to make this sufficiently intelligible, a more extensive exposition than we are able to afford, we must content ourselves with the ordinary language, and with a more familiar mode of considering the subject.

As the object is happiness, that intelligence is one of the qualities in question will not be denied, and may speedily be made to appear. To attain happiness in the greatest possible degree, all the means to that end which the compass of nature affords must be employed in the most perfect possible mode. But all the means which the compass of nature, or the system in which we are placed, affords, can only be known by the most perfect knowledge of that system. The highest measure of knowledge is therefore required. But mere knowledge is not enough; a mere magazine of remembered facts is a useless treasure. Amid the vast variety of known things, there is needed a power of choosing; a power of discerning which of them are conducive, which not, to the ends we have in view. The ingredients of intelligence are two, knowledge and sagacity; the one affording the materials, upon which the other is to be exerted; the one showing what exists, the other converting it to the greatest use; the one bringing within our ken what is capable and what is not capable of being used as means, the other seizing and combining, at the proper moment, whatever is the fittest means to each particular end. This union, then, of copiousness and energy; this possession of numerous ideas, with the masterly command of them, is one of the more immediate ends to which the business of education is to be directed.

With a view to happiness as the end, another quality will easily present itself as indispensable. Conceive that a man knows the materials which can be employed as means, and is prompt and unerring in the mode of combining them; all this power is lost, if there is any thing in his nature which prevents him from using it. If he has any appetite in his nature which leads him to pursue certain things with which the most effectual pursuit of happiness is inconsistent, so far this evil is incurred. A perfect command, then, over a man's appetites and desires; the power of restraining them whenever they lead in a hurtful direction; that possession of himself which insures his judgment against the illusions of the passions, and enables him to pursue constantly what he deliberately approves, is indispensably requisite to enable him to produce the greatest possible quantity of happiness. This is what the ancient philosophers called temperance; not exactly the same with what is called the virtue or grace of temperance, in theological morality, which includes a certain portion (in the doctrines of some theological instructors, a very large portion) of abstinence, and not only of abstinence, or the gratuitous renunciation of pleasure, but of the infliction of voluntary pain. This is done with a view to please the God, or object of worship, and to provide, through his favour, for the happiness of a second or future life. The temperance of the ancient philosophers had a view only to the happiness of the present life; and consisted in the power of resisting the immediate propensity, if yielding to it would lead to an overbalance of evil, or prevent the enjoyment of a superior good, in whatever the good or evil of the present life consists. This resisting power consists of two parts: the power of resisting the allurements of pleasure: and that of resisting the terrors of pain; the last of which has an appropriate name, and is called Fortitude.

These two qualities, the intelligence which can always choose the best possible means, and the strength which overcomes the misguiding propensities, appear to be sufficient for the happiness of the individual himself; to the pursuit of which it cannot be doubted that he has always sufficient motions. But education, we have said, should be an instrument to render the individual the best possible artificer of happiness, not to himself alone, but also to others. What, then, are the qualities with which he ought to be endowed, to make him produce the greatest possible quantity of happiness to others?

It is evident enough to see what is the first grand division. A man can affect the happiness of others either by abstaining from doing them harm, or by doing them positive good. To abstain from doing them harm, receives the name of Justice; to do positive good receives that of Generosity. Justice and generosity, then, are the two qualities by which man is fitted to promote the happiness of his fellow-creatures. And it thus appears, that the four Cardinal Virtues of the ancients do pretty completely include all the qualities, to the possession of which it is desirable that the human mind should be trained. The defect, however, of this description is, that it is far too general. It is evident that the train of mental events which conduct to the proposed results must be far more particularized to insure, in any considerable degree, the effects of instruction; and it must be confessed that the ethical instructions of the ancients failed by remaining too much in generals. What is wanting is, that the incidents of human life should be skilfully classified; both those on the oc-

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casion of which they who are the objects of the good acts are pointed out for the receipt of them, and those, on the occasion of which they who are to be the instruments are called upon for the performance. It thus appears that the science of ethics, as well as the science of intellectuals, must be carried to perfection, before the best foundation is obtained for the science of education.

Of the Nature of Happiness.

III. We have spoken of the qualities which are subservient to human happiness, as means to an end. But, before means can be skilfully adapted to an end, the end must be accurately known. To know how the human mind is to be trained to the promotion of happiness, another inquiry, then, is necessary, Wherein does human happiness consist? This is a controverted question; and we have introduced it rather with a view to show the place which it occupies in the theory of education, than that we have it in our power to elucidate a subject about which there is so much diversity of opinion, and which some of the disputants lead into very subtle and intricate inquiries. The importance of the question is sufficiently evident from this, that it is the grand central point, to which all other questions and inquiries converge; that point, by their bearing upon which the value of all other things is determined. That it should remain itself undetermined, implies, that this branch of philosophy is yet far from its highest point of perfection.

The speculations on this subject, too, may be divided into two great classes; that of those who trace up all the elements of happiness, as they do all those of intellect, to the simple sensations which, by their transformation into ideas, and afterwards into various combinations, compose, they think, all the intellectual and moral phenomena of our nature; another, that of those who are not satisfied with this humble origin; who affirm that there is something in human happiness, and in the human intellect, which soars high above this corporeal level; that there are intellectual as well as moral forms, the resplendent objects of human desire, which can by no means be resolved into the grosser elements of sense. These philosophers speak of eternal and immutable truths; truths which are altogether independent of our limited experience; which are truly universal; which the mind recognizes without the aid of the senses; and which are the objects of pure intellect. They affirm, also, that there is a notion of right and of wrong wholly underived from human experience, and independent of the laws which regulate, in this world, the happiness and misery of human life; a right and wrong, the distinction between which is perceived, according to some, by a peculiar sense; according to others, by the faculty which discerns pure truth; according to others by common sense; it is the same, according to some, with the notion of the fitness and unfitness of things; according to others, with the law of nature; according to others, with truth; and there is one eminent philosopher who makes it depend upon sympathy, without determining very clearly whether sympathy depends upon the senses or not.

We cannot too earnestly exhort philosophers to perfect this inquiry; that we may understand at last, not by vague abstract terms, but clearly and precisely, what are the simple ideas included under the term happiness; and what is the real object to which education is pointed; since it is utterly impossible, while there is any vagueness and uncertainty with respect to the end, that there should be the greatest precision and certainty in combining the means.

Of Education in reference to the Means of forming the Mind.

IV. We come at last to the consideration of the means which are at the disposal of man for endowing the human mind with the qualities on which the generation of happiness depends. It is under this head that the discussion of the practical expedients chiefly occurs. It embraces, also, however, some points of theory.

One of the most important of the remaining questions, of that sort, refers to the degree in which the useful qualities of human nature are, or are not, under the powers of education. This is the subject of a famous controversy, with names of the highest authority on both sides of the question. Helvetius, it is true, stands almost alone, on one side. But Helvetius, alone, is a host. No one man, perhaps, has done so much towards perfecting the *theory* of education as Mons. Helvetius; and his books are pregnant with information of the highest importance. Whoever wishes to understand the ground-work of education, can do nothing more conducive to his end, than to study profoundly the expositions of this philosophical inquirer, whether he adopts his conclusions, in all their latitude, or not. That Helvetius was not more admired, in his own country, is owing really to the value of his work. It was too solid, for the frivolous taste of the gay circles of Paris—assemblies of pampered noblesse, who wished for nothing but amusement. That he has been so little valued, in this country, is, it must be confessed, owing a little to the same cause; but another has concurred. An opinion has prevailed, a false one, that Helvetius is a peculiarly dangerous enemy to religion; and this has deterred people from reading, or rather the old people, who do not read, have deterred the young who do. There is no book, the author of which does not disguise his unbelief, that can be read with more safety to religion. The author attacks nothing but priestcraft, and that in one of the worst of its forms, the popish priestcraft of the dark and middle ages, the idea of which we are well accustomed, in this country, to separate from that of religion in the abstract. When his phraseology at any time extends, and that is not often, to Christianity itself, or to religion in the abstract, there is nothing calculated to seduce. There is nothing epigrammatic, and sparkling in the expression; nothing sophistical and artfully veiled in the reasoning; a plain proposition is stated, with a plain indication of its evidence; and if your judgment is not convinced, you are not deluded through the fancy.

M. Helvetius says, that if you take men who bring into the world with them the original constituents of their nature, their mental and bodily frame, in that ordinary state of goodness which is common to the great body of mankind,—leaving out of the account the comparatively small number of individuals who come into the world imperfect, and manifestly below

the ordinary standard,—you may regard the whole of this great mass of mankind, as equally susceptible of mental excellence; and may trace the causes which make them to differ. If this be so, the power of education embraces every thing between the lowest stage of intellectual and moral rudeness, and the highest state, not only of actual, but of possible perfection. And if the power of education be so immense, the motive for perfecting it is great beyond expression.

The conclusions of Helvetius were controverted directly by Rousseau; and defended, against those strictures, by the author himself. We recollect few writers in this country who have embraced them.* But our writers have contented themselves, rather with rejecting, than disproving; and, at best, have supported their rejection only by some incidental reflection, or the indication of a discrepancy between his conclusions and theirs.

One of the causes, why people have been so much startled, by the extent to which Helvetius has carried the dominion of education, seems to us to arise, from their not including in it nearly so much as he does. They include in it little more than what is expressed by the term schooling; commencing about six or seven years of age, and ending at latest with the arrival of manhood. If this alone is meant by education, it is no doubt true, that education is far indeed from being all-powerful. But if in education is included every thing, which acts upon the being as it comes from the hands of nature, in such a manner as to modify the mind, to render the train of feelings different from what it would otherwise have been; the question is worthy of the most profound consideration. It is probable, that people in general form a very inadequate conception of all the circumstances which act during the first months, perhaps the first moments, of existence, and of the power of those circumstances in giving permanent qualities to the mind. The works of Helvetius would have been invaluable, if they had done nothing more than prove their vast importance, and call to them the concentrated attention of mankind. Rousseau began this important branch of the study of education. He remarked a variety of important facts, which, till his time, had been almost universally neglected, in the minds of infants, and how much might be done, by those who surround them, to give good or bad qualities to their minds, long before the time at which it had been supposed that education could commence. But Helvetius treated the subject much more profoundly and systematically. He traced the circumstances to the very moment of birth; and showed at how wonderfully early an age indelible characters might be impressed; nay, that, of the circumstances over which man has a control (for he speaks not of others), some may be traced even beyond the birth, on which effects of the greatest importance depend.

It is evident how much it imports the science of education, that these circumstances should, by careful and continued observation, be all ascertained, and placed in the order best adapted for drawing from them the most efficient practical rules. This is of more importance than determining the question, whether the prodigious difference which exists among men, ordinarily well organized, is owing wholly to the circumstances which have operated upon them since the first moment of their sensitive existence, or is in part produced by original peculiarities. Enough is ascertained to prove, beyond a doubt, that if education does not perform every thing, there is hardly any thing which it does not perform: that nothing can be more fatal than the error of those who relax in the vigilance of education, because nature is powerful, and either renders it impossible for them to accomplish much, or accomplishes a great deal without them: that the feeling is much more conformable to experience, and much more conformable to utility, which ascribes every thing to education, and thus carries the motive for vigilance and industry, in that great concern, to its highest possible pitch. This much, at any rate, is ascertained, that all the difference which exists, or can ever be made to exist, between one body, or class of men, and another, is wholly owing to education. Those peculiarities, if any such there be, which sink a man below, or elevate him above the ordinary state of aptitude to profit by education, have no operation in the case of large numbers or bodies. But large numbers or bodies of men are raised to a high degree of mental excellence; and might, without doubt, be raised to still higher. Other large bodies, or whole nations, have been found in so very low a mental state, as to be raised but little above the brutes. All this vast distance is undeniably the effect of education. This much, therefore, may be affirmed on the side of Helvetius, that a prodigious difference is produced by education; while, on the other hand, it is rather assumed than proved, that any difference exists, but that which difference of education creates.

Of the *Physical* circumstances which operate in forming the Mind.

The circumstances which are included under the term Education, in the comprehensive sense in which we have defined it, may be divided, we have said, into Physical and Moral. We shall now consider the two classes in the order in which we have named them; and have here again to remind the reader, that we are limited to the task of pointing out what we should wish to be done, rather than permitted to attempt the performance.

1. Three things are desirable with regard to the physical circumstances, which operate in the way of education favourably or unfavourably; to collect them fully; to appreciate them duly; and to place them in the order which is most favourable for drawing from them practical rules.

This is a service (common to the sciences of education and mind) which has been very imperfectly

* There is one brilliant authority on the side of Helvetius: "It was a favourite opinion of Sir William Jones, that all men are born with an equal capacity of improvement." Lord Teignmouth's *Life of Sir William Jones*, Vol. II. p. 217.

rendered. It has been chiefly reserved to medical men to observe the physical circumstances which affect the body and mind of man; but of medical men few have been much skilled in the observation of mental phenomena, or have thought themselves called upon to mark the share which physical circumstances had in producing them. There are indeed some, and those remarkable exceptions. There is Dr Darwin in our own country, and M. Cabanis in France. They have both of them taken the mind as a part at least of their study; and we are highly indebted to them for the number and value of their observations. They are both philosophers, in the most important sense of the word; they both observed nature for themselves, observed her attentively, and with their view steadily directed to the proper end. But still it is not safe to rely upon them implicitly as guides. They were in too great a haste to establish conclusions; and were apt to let their belief run before their evidence. They were not sufficiently careful to distinguish between the different degrees of evidence, and to mark what is required to constitute proof. To do this steadily seems, indeed, to be one of the rarest of all endowments; and was much less the characteristic of the two philosophers, we have named, than a wide range of knowledge, from which they collected the facts, and great ingenuity in combining and applying them. Dr Darwin was the most remarkable, both for the strength and the weakness of which we speak. The work of Darwin, to which we chiefly allude, is the *Zoonomia;* though important remarks to the same effect are scattered in his other publications. Cabanis entitled his great work, *Rapports du Physique et du Moral de l'Homme.* And there are some works recently announced by German physiologists, the titles of which promise aids in the same endeavour. But though we expect from them new facts, and ingenious hints, we have less hope of any great number of sound conclusions.

There are certain general names, already in use, including the greater number of the physical circumstances which operate in the way of education upon the mind. It will be convenient, because of their commonness, to make use of them on the present occasion, though neither the enumeration which they make is complete, nor the distribution logical.

All the physical circumstances which operate upon the mind are either, 1. inherent in the body; or, 2. external to the body. Those which are external to the body operate upon the mind, by first operating upon the body.

Of the first kind, the more remarkable seem to be healthiness or sickliness, strength or weakness, beauty or deformity, the temperament, the age, the sex.

Of the second sort, the more remarkable seem to be the aliment, the labour, the air, temperature, action, rest.

Previous to the inquiry respecting the power which physical circumstances exert in the formation of the mind, it may seem that we ought to determine the speculative question respecting the nature of the mind: that is, whether the phenomena of mind may possibly result from a certain organization of the powers of matter; or whether something of a different kind, and which we call spiritual, must not be conceived, as the source and organ of thought. We do not mean to enter into this controversy, which would detain us too long. It is not, in the least degree, necessary that we should, for the end which we have in view. Whether the one hypothesis, with respect to the mind, be adopted, or the other, the distribution of the circumstances, which operate in the formation of human character, into those commonly called Physical, and those commonly called Moral, will be as convenient a distribution, as the present state of our knowledge enables us to make. And all that inquiry can do, in regard to those circumstances, is, to trace them accurately, and to observe their effects; that is, to ascertain what they are, and what the order of the mental events by which they are followed. This is simply matter of experience; and what we experience is what it is, whatever opinion we adopt with regard to the nature of that which thinks. It is in what we experience, all ascertained, and put into the best possible shape for ease of comprehension and ready application to practice, that all useful knowledge on this, as on all other subjects, consists.

1. First we are to consider the circumstances of the body which have an effect upon the mental sequences. The object is, to ascertain which have a tendency to introduce those sequences which are favourable, which to introduce those that are unfavourable, to human happiness, and how to turn this knowledge to account.

Health and sickness, or the states of body which those names most peculiarly express, are the first of the circumstances which we have enumerated under this head. That these states have a tendency to introduce very different trains of thought is matter of vulgar experience; but very little has been done to examine such trains, and to ascertain what in each is favourable, and what is unfavourable to human happiness.

We have already seen, that the trains which are favourable to Intelligence, Temperance, Generosity, and Justice, are the trains favourable to human happiness. Now, with respect to Intelligence, it will be seen, that Health is partly favourable, and partly unfavourable; and the same is the case with sickness. Health is favourable, by allowing that time to be given to study, which many kinds of sickness withdraws; by admitting a more vigorous attention, which the pain and languor of sickness often divide. It is unfavourable, by introducing that flow of pleasurable ideas, which is called high spirits, in a degree unfavourable to the application of attention; and by leading to that passionate pursuit of pleasure, which diminishes, if it does not destroy, the time for study. The mode in which disease operates upon the mental sequences is a subject of great complexity, and in which little has yet been done to mark distinctly the events, and ascertain the order of their succession. Cabanis, in his seventh memoir, entitled, *De l'Influence des Maladies sur la Formation des Idées et des Affections Morales*, has made a useful beginning toward the elucidation of this subject; but here, as elsewhere, he is too often general and vague. Instruction may also be gleaned from Dar-

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win; but the facts which bear upon this point rather drop from him incidentally, than are anywhere put together systematically for its elucidation. As they were both physicians, however, of great experience, and of unusual skill in the observation of mental phenomena, their opinions are entitled to the greatest respect. The result of the matter is, that an improved medicine is no trifling branch of the art and science of education. Cabanis, accordingly, concludes his memoir with the two following propositions:

"*1mo*, L'état de maladie influe d'une manière directe sur la formation des idées et des affections morales: nous avons même pu montrer dans quelques observations particulières, comment cette influence s'exerce.

"*2do*, L'observation et l'experience nous ayant fait decouvrir les moyens de combattre assez souvent avec succés l'etat de maladie, l'art qui met en usage ces moyens, peut donc modifier et perfectionner les operations de l'intelligence et les habitudes de la volonté."

As it is chiefly through the nervous system, and the centre of that system, the brain, that the mental sequences are affected, and as all the sensitive parts have not an action equally strong, nor equally direct, upon the nerves and brain, diseases affect the mental sequences differently, according to the parts which they invade. The system of the nerves and brain is itself subject to different states of disease. Classified, with regard to the functions which that system performs, as the organ of sensibility and of action, these states are thus described by M. Cabanis: "1. Excess of sensibility to all impressions on the one part; excessive action on the organs of motion on the other. 2. Unfitness to receive impressions, in sufficient number, or with the due degree of energy; and a diminution of the activity necessary for the production of the motions. 3. A general disturbance of the functions of the system, without any remarkable appearance of either excess or defect. 4. A bad distribution of the cerebral virtue, either when it exerts itself unequally in regard to time, having fits of extraordinary activity, followed by others of considerable remission; or when it is supplied in wrong proportion to the different organs, of which some are to a great degree abandoned, while there appears in others a concentration of sensibility, and of the excitations or powers by which the movements are affected."

The effects upon the mental sequences are represented in the following general sketch, which has the advantage of being tolerably comprehensive, though it is unhappily both vague and confused: "We may lay it down as a general fact, that, in all the marked affections of the nerves, irregularities, less or greater, take place, relative both to the mode in which impressions are received, and to the mode in which the determinations, automatic or voluntary, are formed. On one part, the sensations vary incessantly and rapidly with respect to their vivacity, their energy, and even their number; on another, the strength, the readiness, the facility of action exhibit the greatest inequalities. Hence perpetual fluctuation, from great excitement to languor, from elevation to dejection; a temper and passions variable in the highest degree. In this condition, the mind is always easily pushed to extremes. Either the man has many ideas, with great mental activity and acuteness; or he is, on the contrary, almost incapable of thinking. It has been well observed, that hypochondriacal persons are by turns both courageous and cowardly; and as the impressions are habitually faulty either by excess or defect, in regard to almost all objects, it is seldom that the images correspond to the reality of things; that the desires and the will obtain the proper force and direction. If, at the same time with these irregularities, which arise from the nervous system, should be found a weakness of the muscular organs, or of some important viscus, as, for example, of the stomach,—the phenomena, though still analogous in the main, will be distinguished by remarkable peculiarities. During the interval of languor, the debility of the muscles will render the sense of weakness, the fainting and drooping, still more complete and oppressive; life will appear ready to escape at every instant. The passions are gloomy, excited by trifles, selfish; the ideas are petty, narrow, and bear only upon the objects of the slightest sensations. At the times of excitation, which arrive the more suddenly, the greater the weakness; the muscular determinations do not obey the impulses of the brain, unless by starts, which have neither energy nor duration. These impulses serve only to convince the patient more profoundly of his real imbecility; they give him only a feeling of impatience, of discontent, and anxiety. Desires, often sufficiently keen, but commonly repressed by the habitual feeling of weakness, still more increase the discouraging impression. As the peculiar organ of thought cannot act without the concurrence of several others, and as, at that moment, it partakes in some degree of the weakness which affects the organs of movement, the ideas present themselves in crowds; they spring up, but do not arrange themselves in order; the necessary attention is not enjoyed; the consequence is, that this activity of the imagination, which we might expect to afford some compensation for the absence of other faculties, becomes a new source of dejection and despair"

In this passage, the mental sequences which particular states of disease introduce are clearly shown to have a prodigious influence upon human happiness; but the effects which are produced in respect to intelligence, temperance, generosity and justice, are mixed up together; and the author rather shows how much this subject deserves to be studied, than gives us information from which any considerable degree of practical utility can be derived. The connection between particular states of body, and particular mental trains, must be carefully watched and recorded. When the events, one by one, are accurately distinguished, and made easy to be recognized, and when the order in which they follow one another is known, our power over the trains of those events; power to prevent such as are unfavourable, to produce such as are favourable, to human happiness, will then be at its height; and how to

take care of his health will be one of the leading parts of the moral and intellectual education of man.

The state of the body, with regard to health and disease, is the inherent circumstance of the greatest importance, and we must pass over the rest with a cursory notice. The next we mentioned, are, strength and weakness, meaning chiefly muscular strength and weakness; and the natural, habitual, not the accidental, or diseased, state. It is a common enough observation, that muscular strength is apt to withdraw the owner from mental pursuits, and engage him in such as are more of the animal kind; the acquisition and display of physical powers. Few men of great bodily powers have been much distinguished for mental excellence; some of the greatest ornaments of human nature have been remarkable for bodily weakness. Muscular strength is liable to operate unfavourably upon the moral as well as the intellectual trains of thought. It diminishes that respect for other men, which is so necessary to resist the impulses of passion; it presents innumerable occasions for playing the tyrant with impunity; and fosters, therefore, all that train of ideas, in which the tyrannical vices are engendered. Cabanis remarks, and the fact is worthy of the greatest attention,—"Presque tous les grands scélérats sont des hommes d'une structure organique vigoureuse, remarquables par la fermeté et la tenacité de leurs fibres musculaires." It is evident, therefore, how deeply it concerns the happiness of mankind, that the mental trains which this circumstance has a tendency to raise, should be accurately known, as thus alone the means can be known, how that which is hurtful can be avoided, that which is useful be introduced.

Of beauty and deformity, as inherent circumstances which have an effect upon the mental trains, much will not be necessary to be said. Illustrations will occur to every body, to prove, that their power is not inconsiderable; so little, however, has been done to ascertain the facts, and record them in the best possible order, that any thing which deserves the name of knowledge on the subject hardly exists; and the principal service we can render is to point it out for study; to exhort future inquirers, to observe diligently the trains which flow from beauty and deformity as their source, and to trace to the largest possible sequences, as above described, the connections which take place between them. Beauty and deformity, it may be observed, operate upon the mental trains in somewhat a different way from health and disease; rather mediately than immediately. It is the idea of their effect upon other people that is the more immediate cause of the trains to which they give occasion. The idea that beauty commands their favourable regards, is apt to introduce the well-known trains, denoted by the terms, vanity, pride, contemptuousness, trains not very favourable to the virtues. The idea that deformity is apt to excite their unfavourable regards, is often observed to lead to acuteness and vigour of intellect, employed as instruments of protection, but to moroseness, and even malignity of temper. The mode, however, in which beauty and deformity operate upon the mental trains, namely, through the idea of their effect upon other people, is common to them with a great many other advantages or disadvantages, which derive their value chiefly from their influence upon other people; and materials for the illustration of this subject have been supplied by various writers upon the human mind.

To the word Temperament, no very precise idea has hitherto been annexed. It may be conceived in the following manner: The bodily structure, the composition of elements in the body of every individual, is different from that in the body of any other. It is observed, however, that the composition is more nearly resembling in some, than in others; that those who thus resemble may be arranged in groups; and that they may all be comprehended in four or five great classes. The circumstances, in which their bodily composition agrees, so as to constitute one of those large classes, have been called the Temperament; and each of those more remarkable characters of the body has been observed to be attended with a peculiar character in the train of ideas. But the illustration of the trains of ideas, and hence of the qualities of mind, which are apt to be introduced by temperament, and by the diversities of age and of sex, we are obliged, by the rapid absorption of the space allotted us, wholly to omit. The subject in itself is not very mysterious. Accurate observation, and masterly recordation alone are required. To be sure, the same may be said of every object of human inquiry. But in some cases, it is not so easy to conceive perfectly what observation and recordation mean. On these topics, also, we are happy to say, that Cabanis really affords very considerable helps.

We come now to the second sort of physical circumstances, which have the power of introducing habitually certain trains of ideas, and hence of impressing permanent tendencies on the mind,—the circumstances which are external to the body. Some of these are of very great importance. The first is Aliment.

Aliment is good or evil, by quality, and quantity. Hartley has remarked long ago, that though all the impressions from which ideas are copied, are made on the extremities of the nerves which are ramified on the surface of the body, and supply the several organs of sense, that other impressions are nevertheless made on the extremities of the nerves which are ramified on the internal parts of our bodies, and that many of those impressions are associated with trains of ideas; that the impressions made upon the extremities of the nerves which are ramified on the alimentary canal, are associated with the greatest number of those trains; and of such trains, that some are favourable to happiness, some altogether the reverse. If the quantity and quality of the aliment be the principal cause of those impressions, attended by such important effects, here is a physiological reason, of the greatest cogency, for an accurate observation and recordation of the events occurring in this part of the field; of what antecedents are attended by what consequents, and what are the largest sequences which can be traced. Cabanis confirmed this doctrine with regard to the internal impressions, and added another class. He said that not only the extremities of the nerves which termi-

nate internally, but the centre of the nervous influence, the brain itself, received impressions, and that thus there were no fewer than three sources of the mental and corporeal movements of man; one external, from which almost all our distinct ideas are copied; and two internal, which exert a very great influence upon the trains of ideas, and hence upon the actions of which these trains are the antecedents or cause.

On this too, as on most of the other topics, belonging to the physical branch of education, we must note, as still uncollected, the knowledge which the subject requires. It is understood in a general way, that deep impressions are by this means made upon the mind; but how they are made, is a knowledge which, in any such detail and accuracy as to afford useful practical rules, is nearly wanting. There is a passage in Hartley, which we esteem it important to quote: " The sense of feeling may be distinguished into that of the external surface of the body, and that of the cavities of the nose, mouth, fauces, alimentary duct, pelvis, of the kidneys, ureters, bladder of urine, gall-bladder, follicles, and ducts of the glands, &c. The sensibility is much greater in the last than in the first, because the impressions can more easily penetrate through the soft epithelium with which the internal cavities are invested. In the mouth and nose this sensibility is so great, and attended with such distinguishing circumstances, as to have the names of taste and smell assigned respectively to the sensations impressed upon the papillæ of these two organs." . . . . " The taste may also be distinguished into two kinds; viz. the general one which extends itself to the insides of the lips and cheeks, to the palate, fauces, œsophagus, stomach, and whole alimentary duct, quite down to the anus. . . . . . The pleasures of the taste, considered as extending itself from the mouth through the whole alimentary duct, are very considerable, and frequently repeated; they must, therefore, be one chief means, by which pleasurable states are introduced into the brain and nervous system. These pleasurable states must, after some time, leave miniatures of themselves, sufficiently strong to be called up upon slight occasions, viz. from a variety of associations with the common visible and audible objects, and to illuminate these and their ideas. When groupes of these miniatures have been long and closely connected with particular objects, they coalesce into one complex idea, appearing, however, to be a simple one; and so begin to be transferred upon other objects, and even upon tastes back again, and so on without limits. And from this way of reasoning it may now appear, that a great part of our intellectual pleasures are ultimately deducible from those of taste; and that one principal final cause of the greatness and constant recurrency of these pleasures, from our first infancy to the extremity of old age, is to introduce and keep up pleasurable states in the brain, and to connect them with foreign objects. The social pleasures seem, in a particular manner, to be derived from this source, since it has been customary in all ages and nations, and is in a manner necessary, that we should enjoy the pleasures of taste in conjunction with our relations, friends, and neighbours. In like manner, nauseous tastes, and painful impressions upon the alimentary duct, give rise and strength to mental pains. The most common of these painful impressions is that from excess, and the consequent indigestion. This excites and supports those uneasy states, which attend upon melancholy, fear, and sorrow. It appears also to me, that these states are introduced in a great degree during sleep, during the frightful dreams, agitations and oppressions, that excess in diet occasions in the night. These dreams and disorders are often forgotten; but the uneasy states of body which then happen, leave vestiges of themselves, which increase in number and strength every day from the continuance of the cause, till at last they are ready to be called up in crowds upon slight occasions, and the unhappy person is unexpectedly, and at once, as it were, seized with a great degree of the hypochondriac distemper, the obvious cause appearing no ways proportionable to the effect. And thus it may appear that there ought to be a great reciprocal influence between the mind and alimentary duct, agreeably to common observation." Cabanis, in like manner, says, " Quoique les medecins aient dit plusieurs choses hazardées, touchant l'effet des substances alimentaires sur les organs de la pensée, ou sur les principes physiques de nos penchans, il n'en est pas moins certain que les differentes causes que nous appliquons journellement à nos corps, pour en renouveller les mouvemens, agissent avec une grande efficacité sur nos dispositions morales. On se rend plus propre aux travaux de l'esprit par certaines precautions de régime, par l'usage, ou la suppression de certains alimens. Quelques personnes ont été guéries de violens accès de colere, auxquels elles etoient sujêtes, par la seule diète pythagorique, et dans le cas même ou des délires furieux troublent toutes les facultés de l'ame, l'emploi journalier de certaines nourritures ou de certaines boissons, l'impression d'une certaine temperature de l'air, l'aspect de certaines objets; en un mot, un systéme diététique particulier suffit souvent pour y remener le calme, pour faire tout rentrer dans l'ordre primitif."

As it is impossible for us here to attempt a full account of the mode in which aliments operate to produce good or bad effects upon the train of ideas, we shall single out that case, which, as operating upon the greatest number of people, is of the greatest importance; we mean that, in which effects are produced by the *poverty* of the diet; proposing, under the term poverty, to include both badness of quality, and defect of quantity. On badness of quality, we shall not spend many words. Aliments are bad in a variety of ways, and to such a degree as to impair the health of body. Of such, the injurious effect will not be disputed. Others, which have in them no hurtful ingredient, may contain so insignificant a portion of nourishment, that to afford it in the requisite degree, they must produce a hurtful distention of the organs. The saw-dust, which some northern nations use for bread, if depended upon for the whole of their nourishment, would doubtless have this effect. The potatoe, where solely depended upon, is not, perhaps, altogether free from

it. Bad quality, however, is but seldom resorted to, except in consequence of deficient quantity. That is, therefore, the principal point of inquiry.

It is easy to see a great number of ways in which deficient quantity of food operates unfavourably upon the *moral* temper of the mind. As people are ready to sacrifice every thing to the obtaining of a sufficient quantity of food, the want of it implies the most dreadful poverty—that state, in which there is scarcely any source of pleasure, and in which almost every moment is subject to pain. It is found by a very general experience, that a human being, almost constantly in pain, hardly visited by a single pleasure, and almost shut out from hope, loses by degrees all sympathy with his fellow creatures; contracts even a jealousy of their pleasures, and at last a hatred; and would like to see all the rest of mankind as wretched as himself. If he is habitually wretched, and rarely permitted to taste a pleasure, he snatches it, with an avidity; and indulges, with an intemperance, almost unknown to any other man. The evil of insufficient food acts with an influence not less malignant upon the intellectual, than upon the moral, part of the human mind. The physiologists account for its influence in this manner. They say, that the signs, by which the living energy is manifested, may be included generally under the term *irritability*, or the power of being put in action by stimulants. It is not necessary for us to be very particular in explaining these terms; a general conception will for the present suffice. There is a certain degree of this irritability in the frame of man, upon which the proper state, or rather the very existence, of the animal functions seems necessarily to depend. A succession of stimulants, of a certain degree of frequency and strength, is necessary to preserve that irritability. The most important by far of all the useful stimulants applied to the living organs is food. If this stimulant is applied, in less than a sufficient degree, the irritability is diminished in proportion, and all those manifestations of the living energy which depend upon it, mental as well as corporeal, are impaired; the mind loses a corresponding part of its force. We must refer to the philosophical writers on medicine for illustrations and facts, which we have not room to adduce, but which will not be difficult to collect. Dr Crichton places *poor diet* at the head of a list of causes which "weaken attention, and consequently debilitate the whole faculties of the mind." * From this fact, about which there is no dispute, the most important consequences arise. It follows, that when we deliberate about the means of introducing intellectual and moral excellence, into the minds of the principal portion of the people, one of the first things which we are bound to provide for, is, a generous and animating diet; the physical causes must go along with the moral; and nature herself denies, that you shall make a wise and virtuous people, out of a starving one. Men must be happy themselves, before they can rejoice in the happiness of others; they must have a certain vigour of mind, before they can, in the midst of habitual suffering, resist a presented pleasure; their own lives, and the causes of their well-being, must be worth something, before they can value, so as to respect, the life, or well-being, of any other person. This or that individual may be an extraordinary individual, and exhibit mental excellence in the midst of wretchedness; but a wretched and excellent people never yet has been seen on the face of the earth. Though far from fond of paradoxical expressions, we are tempted to say, that a good diet is a necessary part of a good education; for in one very important sense it is emphatically true. In the great body of the people all education is impotent without it.

Labour is the next of the circumstances in our enumeration. We have distinguished labour from action, though action is the genus of which labour is one of the species; because of those species, labour is so much the most important. The muscular operations of the body, by which men generally earn their bread, are the chief part of the particulars which we include under that term. The same distinction is useful here as in the former case; labour is apt to be injurious by its *quality*, and by its *quantity*. That the quality of the labour, in which a man is employed, produces effects, favourable or unfavourable upon his mind, has long been confessed; Dr Smith made the important remark, that the labour in which the great body of the people are employed, has a tendency to grow less and less favourable, as civilization and the arts proceed. The division and subdivision of labour is the principal cause. This confines the attention of the labourer to so small a number of objects, and so narrow a circle of ideas, that the mind receives not that varied exercise, and that portion of aliment, on which almost every degree of mental excellence depends. When the greater part of a man's life is employed in the performance of a few simple operations, in one fixed invariable course, all exercise of ingenuity, all adaptation of means to ends, is wholly excluded and lost, as far as disuse can destroy the faculties of the mind. The minds, therefore, of the great body of the people are in danger of really degenerating, while the other elements of civilization are advancing, unless care is taken, by means of the other instruments of education, to counteract those effects which the simplification of the manual processes has a tendency to produce.

The *quantity* of labour is another circumstance, which deserves attention, in estimating the agents which concur in forming the mind. Labour may be to such a degree severe, as to confine the attention almost wholly to the painful ideas which it brings; and to operate upon the mind with nearly the same effects as an habitual deficiency of food. It operates perhaps still more rapidly; obliterating sympathy, inspiring cruelty and intemperance, rendering impossible the reception of ideas, and paralyzing the organs of the mind. The attentive examina-

* *An Inquiry into the Nature and Origin of Mental Derangement, &c.* By A. Crichton, M. D. I. 274.

Education. tion, therefore, of the facts of this case, is a matter of first rate importance. Two things are absolutely certain;—that, without the bodily labour of the great bulk of mankind, the well-being of the species cannot be obtained;—and that, with the bodily labour of the great bulk of mankind, carried beyond a certain extent, neither intellect, virtue, nor happiness can flourish upon the earth. What, then, is that precious middle point, at which the greatest quantity of good is obtained with the smallest quantity of evil, is, in this part of the subject, the problem to be solved.

The state of defective food and excessive labour, is the state in which we find the great bulk of mankind; the state in which they are either constantly existing, or into which they are every moment threatening to fall. These are two, therefore, in settling the rank among the circumstances which concur in determining the degree of intellect and morality capable of being exhibited in the societies of men, which ought to stand in a very eminent place: the mode of increasing to the utmost, the quantity of intellect, morality, and happiness, in human society, will be very imperfectly understood, till they obtain a new degree of consideration.

We named, still farther, among the physical circumstances which contribute to give permanent characters to the mind, air, temperature, action, and rest. But of these we must leave the illustration wholly to other inquirers. It is mortifying to be obliged to leave a subject, on which so much depends, and for which so little has been done, with so very imperfect an attempt for its improvement. We shall, however, have performed a service of some utility to education, if what we have said has any tendency to lead men to a juster estimate of the physical circumstances which concur in fashioning the human mind, and hence to greater industry and care in studying and applying them.

Of the *Moral* circumstances which operate in forming the Mind.

2. The Moral circumstances which determine the mental trains of the human being, and hence the character of his actions, are of so much importance, that to them the term education has been generally confined: Or rather, the term education has been generally used in so narrow a sense, that it embraces only one of the four classes into which we have thought it convenient to distribute the moral circumstances which operate to the formation of the human mind.

The first of these classes we have comprehended under the term *Domestic Education.* To this the groundwork of the character of most individuals is almost wholly to be traced. The original features are fabricated here; not, indeed, in such a manner as to be unsusceptible of alteration, but in such a manner, decidedly, as to present a good or bad subject for all future means of cultivation. The importance, therefore, of domestic education, needs no additional words to explain it; though it is difficult to restrain a sigh, when we reflect, that it has but now begun to be regarded as within the pale of education; and a few scattered remarks, rather than a full exposition of the subject, is all the information upon it, with which the world has been favoured.

By Domestic Education, we denote all that the child hears and sees, more especially all that it is made to suffer or enjoy at the hands of others, and all that it is allowed or constrained to do, in the house in which it is born and bred, which we shall consider, generally, as the parental.

If we consider, that the mental trains, as explained above, are that upon which every thing depends, and that the mental trains depend essentially upon those sequences among our sensations which have been so frequently experienced as to create a habit of passing from the idea of the one to that of the other,—we shall perceive immediately the reasons of what we have advanced.

It seems to be a law of human nature, that the first sensations experienced produce the greatest effects; more especially, that the earliest repetitions of one sensation after another produce the deepest habit; the strongest propensity to pass immediately from the idea of the one to the idea of the other. Common language confirms this law, when it speaks of the susceptibility of the tender mind. On this depends the power of those associations which form some of the most interesting phenomena of human life. From what other cause does it arise, that the hearing of a musical air, which, after a life of absence, recalls the parental mansion, produces as it were a revolution in the whole being? That the sympathies between brothers and sisters are what they are? On what other cause originally is the love of country founded?—that passionate attachment to the soil, the people, the manners, the woods, the rivers, the hills, with which our infant eyes were familiar, which fed our youthful imaginations, and with the presence of which the pleasures of our early years were habitually conjoined!

It is, then, a fact, that the early sequences to which we are accustomed form the primary habits; and that the primary habits are the fundamental character of the man. The consequence is most important; for it follows, that, as soon as the infant, or rather the embryo, begins to feel, the character begins to be formed; and that the habits, which are then contracted, are the most pervading and operative of all. Education, then, or the care of forming the habits, ought to commence, as much as possible, with the period of sensation itself; and, at no period, is its utmost vigilance of greater importance, than the first.

Very unconnected, or very general instructions, are all that can be given upon this subject, till the proper decompositions and recompositions are performed; in other terms, till the subject is first analyzed, and then systematized; or, in one word, *philosophized*, if we may use that verb in a passive signification. We can, therefore, do little more than exhort to the prosecution of the inquiry.

The steady conception of the End must guide us to the Means. Happiness is the end; and we have circumscribed the inquiry, by naming Intelligence, Temperance, and Benevolence, of which last the two parts are Generosity and Justice, as the grand qualities of mind, through which this end is to be attained. The question, then, is, how can those early sequences be made to take place on which the habits, conducive to intelligence, temperance, and be-

nevolence, are founded; and how can those sequences, on which are founded the vices opposite to those virtues, be prevented?

Clearness is attained, by disentangling complexity: we ought, therefore, to trace the sequences conducive to each of those qualities in their turn. A part, however, must suffice, when we cannot accomplish the whole. Intelligent trains of ideas constitute intelligence. Now trains of ideas are intelligent, when the sequences in the ideas correspond to the sequences in nature. A man, for example, knows the order of certain words, when his idea of the one follows that of the other, in the same order in which the events themselves took place. A man is sagacious in devising means for the production of events when his ideas run easily in trains which are at once agreeable to knowledge, that is, to the trains of events, and at the same time new in the combination. They must be agreeable to knowledge; that is, one of the ideas must follow another in the order in which the objects of which they are the ideas follow one another in nature, otherwise the train would consist of mere chimeras, and, having no connection with things, would be utterly useless. As the event, however, is not in the ordinary course, otherwise sagacity would not be required to give it existence, the ordinary train of antecedents will not suffice; it must be a peculiar train, at once correspondent with nature, and adapted to the end. The earliest trains, produced in the minds of children, should be made to partake as much as possible of those characters. The impressions made upon them should correspond to the great and commanding sequences established among the events on which human happiness principally depends. More explicitly, children ought to be made to see, and hear, and feel, and taste, in the order of the most invariable and comprehensive sequences; in order that the ideas which correspond to their impressions, and follow the same order of succession, may be an exact transcript of nature, and always lead to just anticipations of events. Especially, the pains and pleasures of the infant, the deepest impressions which he receives, ought, from the first moment of sensation, to be made as much as possible to correspond to the real order of nature. The moral procedure of parents is directly the reverse; who strive to defeat the order of nature, in accumulating pleasures to their children, and in preventing the arrival of pains, when the children's own conduct would have had very different effects.

Not only are the impressions, from which ideas are copied, made, by the injudicious conduct of those to whom the destiny of infants is confided, to follow an order very different from the natural one, or that in which the grand sequences among events would naturally produce them; but wrong trains of ideas, trains which have no correspondence to the order of events, are often introduced immediately by words, or other signs of the ideas, of other men. As we can only give very partial examples of a general error, we may content ourselves with one of the most common. When those who are about children express by their words, or indicate by other signs, that terrific trains of ideas are passing in their minds, when they go into the dark; terrific trains, which have nothing to do with the order of events, come up also in the minds of the children in the dark, and often exercise an uncontrollable sway during the whole of their lives.—This is the grand source of wrong education; to this may be traced the greater proportion of all the wrong biases of the human mind.—If an order of ideas, correspondent to the order of events, were taught to come up in the minds of children when they go into the dark, they would think of nothing but the real dangers which are apt to attend it, and the precautions which are proper to be taken; they would have no wrong feelings, and their conduct would be nothing but that which prudence, or a right conception of the events, would prescribe.—If the expressions, and other signs of the ideas, of those who are about children, indicate that trains, accompanied with desire and admiration, pass in their minds when the rich and powerful are named, trains accompanied with aversion and contempt when the weak and the poor; the foundation is laid of a character stained with servility to those above, and tyranny to those below.—If indication is given to children that ideas of disgust, of hatred, and detestation, are passing in the minds of those about them, when particular descriptions of men are thought of; as men of different religions, different countries, or different political parties in the same country, a similar train becomes habitual in the minds of the children, and those antipathies are generated which infuse so much of its bitterness into the cup of human life.

We can afford to say but very few words on the powers of domestic education with regard to Temperance. That virtue bears a reference to pain and pleasure. The grand object evidently is, to connect with each pain and pleasure those trains of ideas, which, according to the order established among events, tends most effectually to increase the sum of pleasures, upon the whole, and diminish that of pains. If the early trains create a habit of over-valuing any pleasure or pain, too much will be sacrificed, during life, to obtain the one, or avoid the other, and the sum of happiness, upon the whole, will be impaired. The order in which children receive their impressions, as well as the order of the trains which they copy from others, has a tendency to create impatience under privation; in other words, to make them in prodigious haste to realize a pleasure as soon as desired, to extinguish a pain as soon as felt. A pleasure, however, can be realized in the best possible manner, or a pain removed, only by certain steps,—frequently numerous ones; and if impatience hurries a man to overlook those steps, he may sacrifice more than he gains. The desirable thing would be, that his ideas should always run over those very steps, and none but them; and the skilful use of the powers we have over the impressions and trains of his infancy would lay the strongest foundation for the future happiness of himself, and of all those over whom his actions have any sway. It is by the use of this power that almost every thing is done to create what is called the temper of the individual; to render him irascible on the one hand, or forbearing on the other; severe and unforgiving, or indulgent and placable.

Intelligence and Temperance are sometimes spoken of, as virtues which have a reference to the happiness of the individual himself: Benevolence as a virtue which has a reference to the happiness of others. The truth is, that intelligence and temperance have a reference not less direct to the happiness of others than to that of the individual; and Benevolence cannot be considered as less essential than they to the happiness of the individual. In reality, as the happiness of the individual is bound up with that of his species, that which affects the happiness of the one, must also, in general, affect that of the other.

It is not difficult, from the expositions we have already given, to conceive in a general way, how sequences may take place in the mind of the infant, which are favourable to benevolence, and how sequences may take place which are unfavourable to it. The difficulty is, so to bring forward and exhibit the details, as to afford the best possible instruction for practice. We have several books now in our own language, in particular those of Miss Edgeworth, which afford many finely selected instances, and many detached observations of the greatest value, for the cultivation of benevolence in the infant mind. But the great task of the philosopher, that of *theorizing* the whole, is yet to be performed. What we mean by "theorizing the whole," after the explanations we have already afforded, is not, we should hope, obscure. It is, to observe exactly the facts; to make a perfect collection of them, nothing omitted that is of any importance, nothing included of none; and to record them in that order and form, in which all that is best to be done in practice (that is, in what manner the sequences established in nature may be turned most effectually to the production of a certain end) can be most immediately and certainly perceived.

The order of the impressions which are made upon the child by the spontaneous order of events, is, to a certain degree, favourable to benevolence. The pleasures of those who are about him are most commonly the cause of pleasure to himself; their pains of pain. When highly pleased, they are commonly more disposed to exert themselves to gratify him. A period of pain or grief in those about him, is a period of gloom,—a period in which little is done for pleasure,—a period in which the pleasures of the child are apt to be overlooked. Trains of pleasurable ideas are thus apt to arise in his mind, at the thought of the pleasurable condition of those around him; trains of painful ideas at the thought of the reverse; and he is thus led to have an habitual desire for the one,—aversion to the other. But if pleasures, whencesoever derived, of those about him, are apt to be the cause of good to himself, those pleasures which they derive from himself are in a greater degree the cause of good to himself. If those about him are disposed to exert themselves to please him when they are pleased themselves, they are disposed to exert themselves in a much greater degree to please *him*, in particular, when it is he who is the cause of the pleasure they enjoy. A train of ideas, in the highest degree pleasurable, may thus habitually pass through his mind at the thought of happiness to others, produced by himself; a train of ideas, in the highest degree painful, at the thought of misery to others, produced by himself: and in this manner the foundation of a life of beneficence is laid.

The business of a skilful education is, so to arrange the circumstances by which the child is surrounded, that the impressions made upon him shall be in the order most conducive to this happy result. The impressions, too, which are made originally upon the child are but one of the causes of the trains which are rendered habitual to him, and which therefore obtain a leading influence on his mind. When he is often made to conceive the trains of other men, by the words, or other signs by which their feelings are betokened, those borrowed trains become also habitual, and exert a similar influence on the mind. This, then, is another of the instruments of education. When the trains signified to the child of the ideas in the minds of those about him are trains of pleasure at the thought of the happiness of other human beings, trains of the opposite kind at the conception of their misery; and when the trains are still more pleasurable or painful at the thought of the happiness or misery produced by themselves, the association becomes in time sufficiently powerful to govern the life.

The grand object of human desire is a command over the wills of other men. This may be attained, either by qualities and acts which excite their love and admiration, or by those which excite their terror. When the education is so wisely conducted as to make the train run habitually from the conception of the good end to the conception of the good means; and as often, too, as the good means are conceived, viz. the useful and beneficial qualities, to make it run on to the conception of the great reward, the command over the wills of men; an association is formed which impels the man through life to pursue the great object of desire, by fitting himself to be, and by actually becoming the instrument of the greatest possible quantity of benefit to his fellow men.

But, unhappily, a command over the wills of men may be obtained by other means than by doing them good; and these, when a man can command them, are the shortest, the easiest, and the most effectual. These other means are all summed up in a command over the pains of other men. When a command over the wills of other men is pursued by the instrumentality of pain, it leads to all the several degrees of vexation, injustice, cruelty, oppression, and tyranny. It is, in truth, the grand source of all wickedness, of all the evil which man brings upon man. When the education is so deplorably bad as to allow an association to be formed in the mind of the child between the grand object of desire, the command over the wills of other men, and the fears and pains of other men, as the means; the foundation is laid of bad character,—the bad son, the bad brother, the bad husband, the bad father, the bad neighbour, the bad magistrate, the bad citizen,—to sum up all in one word, the bad man. Yet, true it is, a great part of education is still so conducted as to form that association. The child, while it yet hangs at the breast, is often allowed to find out by expe-

rience, that crying, and the annoyance which it gives, is that by which chiefly it can command the services of its nurse, and obtain the pleasures which it desires. There is not one child in fifty who has not learned to make its cries and wailings an instrument of power, and very often an instrument of absolute tyranny. When the evil grows to excess, the vulgar say the child is spoiled. Not only is the child allowed to exert an influence over the wills of others by means of their pains, it finds, that frequently, sometimes most frequently, its own will is needlessly and unduly commanded by the same means, pain, and the fear of pain. All these sensations concur in establishing a firm association between the idea of the grand object of desire, command over the acts of other men, and those of pain and terror, as the means of acquiring it. That those who have been subject to tyranny are almost always desirous of being tyrants in their turn; that is to say, that a strong association has been formed in their minds between the ideas of pleasure and dignity, on the one hand, and those of the exercise of tyranny, on the other, is a matter of old and invariable observation. An anecdote has just been mentioned to us, so much in point, that we will repeat it, as resting on its own probability, though it is by hearsay testimony (very good, however, of its kind) by which it has reached us. At Eton, in consequence, it is probable, of the criticisms which the press has usefully made upon the system of *fagging* (as it is called) at the public schools, a proposition was lately made, among the boys themselves, for abolishing it. The idea originated with the elder boys, who were in possession of the power,—a power of a very unlimited and formidable description,—and was by them warmly supported; but it was opposed with still greater vehemence by the junior boys, the boys who were then the victims of it, so much did the expected pleasure of tyrannizing in their turn outweigh the pain of their present slavery.—In this case, too, as in most others, the sources of those trains which govern our lives are two,—the impressions made upon ourselves, and the trains which we copy from others. Besides the impressions just recounted, if the trains which pass in the minds of those by whom the child is surrounded, and which he is made to conceive by means of their words, and other signs, lead constantly from the idea of command over the wills of other men, as the grand object of desire, to the ideas of pain and terror as the means, the repetition of the copied trains increases the effect of the native impressions, and establishes and confirms the maleficent character. These are the few things we can afford to adduce upon the subject of Domestic Education.

In the next place comes that which we have denominated *Technical*. To this the term Education has been commonly confined; or, rather, the word Education has been used in a sense so unhappily restricted, that it has extended only to a part of that which we call *Technical Education*. It has not extended to all the arts, but only to those which have been denominated *liberal*.

The question here occurs, What is the sort of education required for the different classes of society, and what should be the difference in the training provided for each? Before we can treat explicitly of technical education, we must endeavour to show, in what manner at least, this question ought to be resolved.

There are certain qualities, the possession of which is desirable in all classes: There are certain qualities, the possession of which is desirable in some, not in others. As far as those qualities extend which ought to be common to all, there ought to be a correspondent training for all. It is only in respect to those qualities which are not desirable in all, that a difference in the mode of training is required.

What then are the qualities, the possession of which is desirable in all? They are the qualities which we have already named as chiefly subservient to the happiness of the individual himself, and of other men,—Intelligence, Temperance, and Benevolence. It is very evident that all these qualities are desirable in all men; and if it were possible to get them all in the highest possible degree in all men, so much the more would human nature be exalted.

The chief difficulty respects Intelligence; for it will be readily allowed, that almost equal care ought to be taken, in all classes, of the trains leading to the settled dispositions which the terms Temperance and Benevolence denote. Benevolence, as we have above described it, can hardly be said to be of more importance to the happiness of man in one class than in another. If we bear in mind, also, the radical meaning of Temperance, that it is the steady habit of resisting a present desire, for the sake of a greater good, we shall readily grant, that it is not less necessary to happiness in one rank of life than in another. It is only necessary to see, that temperance, though always the same disposition, is not always exerted on the same objects, in the different conditions of life. It is no demand of temperance, in the man who can afford it, to deny himself animal food; it may be an act of temperance in the man whose harder circumstances require that he should limit himself to coarser fare. It is also true, that the trains which lead to Temperance and Benevolence may be equally cultivated in all classes. The impressions which they are made to receive, and the trains of others which they are made to copy, may, with equal certainty, be guided to the generating of those two qualities in all the different classes of society. We deem it unnecessary (here, indeed, it is impossible) to enter into the details of what may be done in the course of technical education, to generate, or to confirm, the dispositions of Temperance and Benevolence. It can be nothing more than the application of the principles which we developed, when we endeavoured to show in what manner the circumstances of domestic education might be employed for generating the trains on which these mental qualities depend.

Technical Education we shall then consider as having chiefly to do with *Intelligence*.

The first question, as we have said before, respects what is desirable for all,—the second what is desirable for each of the several classes. Till recently,

it was denied, that intelligence was a desirable quality in the great body of the people; and as intelligence is power, such is an unavoidable opinion in the breasts of those who think that the human race ought to consist of two classes,—one that of the oppressors, another that of the oppressed. The concern which is now felt for the education of the working classes, shows that we have made a great step in knowledge, and in that genuine morality which ever attends it.

The analysis of the ideas decides the whole matter at once. If education be to communicate the art of happiness, and if intelligence consists of two parts,—a knowledge of the order of those events of nature on which our pleasures and pains depend—and the sagacity which discovers the best means for the attaining of ends,—the question, whether the people should be educated, is the same with the question, whether they should be happy or miserable. The question, whether they should have more or less of intelligence, is merely the question, whether they should have more or less of misery, when happiness might be given in its stead. This has been seized, and made use of as an objection, viz. that men are seen by daily experience, not to be happy, not to be moral, in proportion to their knowledge. It is wonderfully shallow. Hume said long ago, that knowledge, and its accompaniments, morality and happiness, may not be strictly conjoined in every individual, but they are infallibly so in every age and in every country. The reason is plain: a natural cause may be hindered of its operation in one particular instance, though in a great variety of instances it is sure to prevail. Besides, there may be a good deal of knowledge in an individual, but not knowledge of the best things; this cannot easily happen in a whole people; neither the whole nor the greater part will miss the right objects of knowledge, when knowledge is generally diffused.

As evidence of the vast progress which we have made in right thinking upon this subject, we cannot help remarking, that even when Milton and Locke wrote upon education, though both men of so much benevolence to the larger family of mankind, and both men whose sentiments were democratical, they yet seem to have had in their view no education but that of the *gentleman*; education had not presented itself, even to their minds, as a blessing in which the indigent orders could be made to partake.

As we strive for an equal degree of justice, an equal degree of temperance, an equal degree of veracity, in the poor as in the rich, so we should strive for an equal degree of intelligence, if there were not a cause which prevents. It is absolutely necessary for the existence of the human race, that labour should be performed, that food should be raised, and other things provided which human welfare requires. A large portion of mankind is required for this labour. Now, then, in regard to all this portion of mankind, that labours, only such a portion of time can by them be given to the acquisition of intelligence as can be abstracted from labour. The difference between intelligence and the other qualities desirable in the mind of man, is this,—that much of time, exclusively devoted to the fixing of the associations on which they depend is not necessary; such trains may go on while other things are attended to, and amid the whole of the business of life. The case, to a certain extent, is the same with intelligence; but, to a great extent, it is not. Time must be exclusively devoted to the acquisition of it; and there are degrees of command over knowledge to which the whole period of human life is not more than sufficient. There are degrees, therefore, of intelligence which must be reserved to those who are not obliged to labour.

The question is (and it is a question which none can exceed in magnitude), What is the degree attainable by the most numerous class? To this we have no doubt, it will, in time, very clearly appear, that a most consolatory answer may be given. We have no doubt it will appear that a very high degree is attainable by them. It is now almost universally acknowledged, that, on all conceivable accounts, it is desirable that the great body of the people should not be wretchedly poor; that when the people are wretchedly poor, all classes are vicious, all are hateful, and all are unhappy. If so far raised above wretched poverty as to be capable of being virtuous, though it is still necessary for them to earn their bread by the sweat of their brow, they are not bound down to such incessant toil as to have no time for the acquisition of knowledge, and the exercise of intellect. Above all, a certain portion of the first years of life are admirably available to this great end. With a view to the productive powers of their very labour, it is desirable that the animal frame should not be devoted to it before a certain age, before it has approached the point of maturity. This holds in regard to the lower animals: a horse is less valuable, less, in regard to that very labour for which he is valuable at all, if he is forced upon it too soon. There is an actual loss, therefore, even in productive powers, even in good economy, and in the way of health and strength, if the young of the human species are bound close to labour before they are fifteen or sixteen years of age. But if those years are skilfully employed in the acquisition of knowledge, in rendering all those trains habitual on which intelligence depends, it may be easily shown that a very high degree of intellectual acquirements may be gained; that a firm foundation may be laid for a life of mental action, a life of wisdom, and reflection, and ingenuity, even in those by whom the most ordinary labour will fall to be performed. In proof of this, we may state, that certain individuals in London, a few years ago, some of them men of great consideration among their countrymen, devised a plan for filling up those years with useful instruction,—a plan which left the elements of hardly any branch of knowledge unprovided for, and at an expence which would exceed the means of no class of a population, raised above wretched poverty to that degree which all men profess to desire. Mr Bentham called this plan of instruction by the Greek name *Chrestomathia*; and developed his own ideas of the objects and mode of instruction, with that depth and comprehension which belong to him, in a work

which he published under that name.* Of the practicability of the scheme no competent judge has ever doubted; and the difficulty of collecting funds is the only reason why it has not, already, been demonstrated by experiment, how much of that intelligence which is desirable for all may be communicated to all.†

Education.

Beside the knowledge or faculties which all classes

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* *Chrestomathia*, being a collection of papers explanatory of the design of an institution proposed to be set on foot, under the name of the Chrestomathic Day-school, &c. By Jeremy Bentham, Esq.

† We mention with extraordinary satisfaction, that an idea of education, hardly less extensive than what is here alluded to, has been adopted by that enlightened and indefatigable class of men, the Baptist Missionaries in India, for the population, poor as well as ignorant, of those extensive and populous regions. A small volume, entitled, "*Hints relative to Native Schools, together with the Outline of an Institution for their Extension and Management*," was printed at the mission press at Serampore in 1816; and, as it cannot come into the hands of many of our readers, we gladly copy from it the following passage, in hopes that the example may be persuasive with many of our countrymen at home:

"It is true, that when these helps are provided, namely, a correct system of orthography, a sketch of grammar, a simplified system of arithmetic, and an extended vocabulary, little is done beyond laying the foundation. Still, however, this foundation must be laid, if any superstructure of knowledge and virtue be attempted relative to the inhabitants of India. Yet, were the plan to stop here, something would have been done. A peasant, or an artificer, thus rendered capable of writing as well as reading his own language with propriety, and made acquainted with the principles of arithmetic, would be less liable to become a prey to fraud among his own countrymen, and far better able to claim for himself that protection from oppression which it is the desire of every enlightened government to grant. But the chief advantage derivable from this plan is, its facilitating the reception of ideas which may enlarge and bless the mind in a high degree,—ideas for which India must be indebted to the west, at present the seat of science, and for the communication of which, generations yet unborn will pour benedictions on the British name.

"1. To this, then, might be added a concise, but perspicuous account of the solar system, preceded by so much of the laws of motion, of attraction, and gravity, as might be necessary to render the solar system plain and intelligible. These ideas, however, should not be communicated in the form of a treatise, but in that of simple axioms, delivered in short and perspicuous sentences. This method comes recommended by several considerations: it agrees with the mode in which doctrines are communicated in the *Hindoo Shastras*, and is therefore congenial with the ideas of even the learned among them; it would admit of these sentences being written from dictation, and even committed to memory with advantage, as well as of their being easily retained; and, finally, the conciseness of this method would allow of a multitude of truths and facts relative to astronomy, geography, and the principal phenomena of nature, being brought before youth within a very small compass.

"2. This abstract of the solar system might be followed by a compendious view of geography on the same plan, that of comprising every particular in concise but luminous sentences. In this part it would be proper to describe Europe particularly, because of its importance in the present state of the world; and Britain might, with propriety, be allowed to occupy in the compendium, that pre-eminence among the nations which the God of Providence has given her.

"3. To these might be added a number of popular truths and facts relative to natural philosophy. In the present improved state of knowledge, a thousand things have been ascertained relative to light, heat, air, water, to meteorology, mineralogy, chemistry, and natural history, of which the ancients had but a partial knowledge, and of which the natives of the East have as yet scarcely the faintest idea. These facts, now so clearly ascertained, could be conveyed in a very short compass of language, although the process of reasoning, which enables the mind to account for them, occupies many volumes. A knowledge of the facts themselves, however, would be almost invaluable to the Hindoos, as these facts would rectify and enlarge their ideas of the various objects of nature around them; and while they, in general, delighted as well as informed those who read them, they might inflame a few minds of a superior order with an unquenchable desire to know *why* these things are so, and thus urge them to those studies, which in Europe have led to the discovery of these important facts.

"4. To this view of the solar system of the earth, and the various objects it contains, might, with great advantage, be added such a compendium of history and chronology united, as should bring them acquainted with the state of the world in past ages, and with the principal events which have occurred since the creation of the world. With the creation it should commence, describe the primitive state of man, the entrance of evil, the corruption of the antediluvian age, the flood, and the peopling of the earth anew from one family, in which the compiler should avail himself of all the light thrown on this subject by modern research and investigation; he should particularly notice the nations of the east, incorporating, in their proper place, the best accounts we now have both of India and China. He should go on to notice the call of Abraham, the giving of the decalogue, the gradual revelations of the Scriptures of Truth, the settlement of Greece, its mythology, the Trojan war, the four great monarchies, the advent of the Saviour of men, the persecutions of the Christian church, the rise of Mahometanism, the origin of the papacy, the invention of printing, of gunpowder, and the mariner's compass, the reformation, the discovery of the passage to India by sea, and the

should possess in common, there are branches of knowledge and art which they cannot all acquire; and, in respect to which, education must undergo a corresponding variety. The apprenticeships, for example, which youths are accustomed to serve to the useful arts, we regard as a branch of their education. Whether these apprenticeships, as they have hitherto been managed, have been good instruments of education, is a question of importance, about which there is now, among enlightened men, hardly any diversity of opinion. When the legislature undertakes to do for every man, what every man has abundant motives to do for himself, and better means than the legislature; the legislature takes a very unnecessary, commonly a not very innocent trouble. Into the details, however, of the best mode of teaching, to the working people, the arts by which the different commodities useful or agreeable to man are provided, we cannot possibly enter. We must content ourselves with marking it out as a distinct branch of the subject, and an important object of study.

With respect to the education of that class of society who have wealth and time for the acquisition of the highest measure of intelligence, there is one question as to which every body must be ripe for a decision. If it be asked, whether, in the constitution of any establishment for their education, call it university, call it college, school, or any thing else, there ought to be a provision made for perpetual improvement,—a provision to make it keep pace with the human mind; or if, on the other hand, it ought to be so constituted as that there shall not only be no provision for, but a strong spirit of resistance to all improvement,—a passion of adherence to whatever was established in a dark age, and a principle of hatred to those by whom improvement is proposed;—all indifferent men will declare that such institutions would be a curse rather than a blessing. That he is a *progressive* being, is the grand distinction of man; he is the only progressive being upon this globe; when he is the most rapidly progressive, then he most completely fulfils his destiny; an institution for *education* which is hostile to progression, is, therefore, the most preposterous, and vicious thing, which the mind of man can conceive.

There are several causes which tend to impair the utility of old and opulent establishments for education. Their love of ease makes them love easy things, if they can derive from them as much credit, as they would from others which are more difficult. They endeavour, therefore, to give an artificial value to trifles. Old practices, which have become a hackneyed routine, are commonly easier than to make improvements; accordingly, they oppose improvements, even when it happens that they have no other interest in the preservation of abuses. Hardly is there a part of Europe in which the universities are not recorded, in the annals of education, as the enemies of all innovation. "A peine la compagnie de Jesus," says d'Alembert, "commença-t-elle à se montrer en France, qu'elle essuya des difficultés sans nombre pour s' y établir. Les universités sur tout firent les plus grands efforts, pour écarter ces nouveaux venus. Les Jesuites s' annonçaient pour enseigner gratuitement, ils comptoient déja parmi eux des hommes savans et célèbres, superieurs peut-être à ceux dont les universités pouvaient se glorifier; l' interêt et la vanité pouvaient done suffire à leurs adversaires pour chercher à les exclure. Ou se rapelle les contradictions semblables que les ordres mendians essuyerent de ces mêmes universités quand ils voulurent s' y introduire; contradictions fondées à peu près sur les mêmes motifs." (*Destruction des Jesuites in France.*) The celebrated German philosopher Wolf remarks the aversion of the universities to all improvement, as a notorious thing, founded upon adequate motives, in the following terms: "*Non adeo impune turbare licet scholarum quietem, et docentibus lucrosam, et disentibus jucundam.*" (Wolfii *Logica*, Dedic. p. 2.)

But though such and so great are the evil tendencies which are to be guarded against in associated seminaries of education,—evil tendencies which are apt to be indefinitely increased when they are united with an ecclesiastical establishment, because, whatever the vices of the ecclesiastical system, the universities have in that case an interest to bend the whole force of their education to the support of them all, and the human mind can only be rendered the friend of abuses in proportion as it is vitiated intellectually, or morally, or both; it must, notwithstanding, be confessed, that there are great advantages in

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various discoveries of modern science. Such a synopsis of history and chronology, composed on the same plan, that of comprising each event in a concise but perspicuous sentence, would exceedingly enlarge their ideas relative to the state of the world, certainly not to the disadvantage of Britain, whom God has now so exalted as to render her almost the arbitress of nations.

"5. Lastly, It would be highly proper to impart to them just ideas of themselves, relative both to body and mind, and to a future state of existence, by what may be termed a Compendium of Ethics and Morality. The complete absence of all just ideas of this kind, is the chief cause of that degradation of public morals so evident in this country.

"These various compendiums, after being written from dictation, in the manner described in the next section, might also furnish matter for reading; and when it is considered that, in addition to the sketch of grammar, the vocabulary, and the system of arithmetic, they include a view of the solar system, a synopsis of geography, a collection of facts relative to natural objects, an abstract of general history, and a compendium of ethics and morality, they will be found to furnish sufficient matter for reading while youth are at school."

Why should not the same idea be pursued in England, and as much knowledge conveyed to the youth of all classes at school, as the knowledge of the age, and the allotted period of schooling will admit?

putting it in the power of the youth to obtain all the branches of their education in one place; even in assembling a certain number of them together, when the principle of emulation acts with powerful effect; and in carrying on the complicated process according to a regular plan, under a certain degree of discipline, and with the powerful spur of publicity. All this ought not to be rashly sacrificed; nor does there appear to be any insuperable difficulty in devising a plan for the attainment of all these advantages, without the evils which have more or less adhered to all the collegiate establishments which Europe has yet enjoyed.

After the consideration of these questions, we ought next to describe, and prove by analysis, the exercises which would be most conducive in forming those virtues which we include under the name of intelligence. But it is very evident, that this is a matter of detail far too extensive for so limited a design as ours. And though education, in common language, means hardly any thing more than making the youth perform those exercises; and a treatise on education means little more than an account of them, we must content ourselves with marking the place which the inquiry would occupy in a complete system, and proceed to offer a few remarks on the two remaining branches of the subject, *Social Education*, and *Political Education*.

The branches of moral education, heretofore spoken of, operate upon the individual in the first period of life, and when he is not as yet his own master. The two just now mentioned operate upon the whole period of life, but more directly and powerfully after the technical education is at an end, and the youth is launched into the world under his own control.

Social Education is that in which society is the Institutor. That the society in which an individual moves, produces great effects upon his mode of thinking and acting, every body knows by indubitable experience. The object is, to ascertain the extent of this influence, the mode in which it is brought about, and hence the means of making it operate in a good, rather than an evil direction.

The force of this influence springs from two sources: the principle of imitation; and the power of the society over our happiness and misery.

We have already shown, that when, by means of words, and other signs of what is passing in the minds of other men, we are made to conceive, step by step, the trains which are governing them, those trains, by repetition, become habitual to our own minds, and exert the same influence over us as those which arise from our own impressions. It is very evident, that those trains which are most habitually passing in the minds of all those individuals by whom we are surrounded, must be made to pass with extraordinary frequency through our own minds, and must, unless where extraordinary means are used to prevent them from producing their natural effect, engross to a proportional degree the dominion of our minds. With this slight indication of this source of the power which society usurps over our minds, that is, of the share which it has in our education, we must content ourselves, and pass to the next.

Nothing is more remarkable in the proceedings of human nature, than the intense desire which we feel of the favourable regards of mankind. Few men could bear to live under an exclusion from the breast of every human being. It is astonishing how great a portion of all the actions of men are directed to this object and to no other. The greatest princes, the most despotical masters of human destiny, when asked, What they aim at by their wars and conquests? would answer, if sincere, as Frederic of Prussia answered, *pour faire parler de soi;* to occupy a large space in the admiration of mankind. What are the ordinary pursuits of wealth and of power, which kindle to such a height the ardour of mankind? Not the mere love of eating and of drinking, or all the physical objects together, which wealth can purchase or power command. With these every man is at bottom speedily satisfied. It is the easy command, which those advantages procure over the favourable regards of society,—it is this, which renders the desire of wealth unbounded, and gives it that irresistible influence which it possesses in directing the human mind.

Whatever, then, are the trains of thought, whatever is the course of action which most strongly recommends us to the favourable regards of those among whom we live, these we feel the strongest motive to cultivate and display; whatever trains of thought and course of action expose us to their unfavourable regards, these we feel the strongest motives to avoid. These inducements, operating upon us continually, have an irresistible influence in creating habits, and in moulding, that is, educating us, into a character conformable to the society in which we move. This is the generable principle; it might be illustrated in detail by many of the most interesting and instructive phenomena of human life; it is an inquiry, however, in which we must not indulge.

To what extent the habits and character, which those influences tend to produce, may engross the man, will no doubt depend, to a certain degree, upon the powers of the domestic and technical education which he has undergone. We may conceive that certain trains might, by the skilful occupation of the early years, be rendered so habitual as to be uncontrollable by any habits which the subsequent period of life would induce, and that those trains might be the decisive ones on which intelligent and moral conduct depends. The influence of a vicious and ignorant society would in this case be greatly reduced; but still, the actual rewards and punishments which society has to bestow upon those who please, and those who displease it; the good and evil which it gives or withholds, are so great, that to adopt the opinions which it approves, to perform the acts which it admires, to acquire the character, in short, which it "delighteth to honour," can seldom fail to be the leading object of those of whom it is composed. And as this potent influence operates upon those who conduct both the domestic education and the technical, it is next to impossible that the trains which are generated, even during the time of their operation, should not fall in with, instead of counteracting, the trains which the social education produces; it is next to impossible, therefore, that the whole man should not take the shape which that influence is calculated to impress upon him.

The *Political Education* is the last, which we have undertaken to notice, of the agents employed in forming the character of man. The importance of this subject has not escaped observation. Some writers have treated of it in a comprehensive and systematical manner. And a still greater number have illustrated it by occasional and striking remarks. It is, nevertheless, true, that the full and perfect exposition of it yet remains to be made.

The Political Education is like the key-stone of the arch; the strength of the whole depends upon it. We have seen that the strength of the Domestic and the Technical Education depends almost entirely upon the Social. Now it is certain, that the nature of the social depends almost entirely upon the Political; and the most important part of the Physical (that which operates with greatest force upon the greatest number, the state of aliment and labour of the lower classes), is, in the long-run, determined by the action of the political machine. The play, therefore, of the political machine acts immediately upon the mind, and with extraordinary power; but this is not all; it also acts upon almost every thing else by which the character of the mind is apt to be formed.

It is a common observation, that such as is the direction given to the desires and passions of men, such is the character of the men. The direction is given to the desires and passions of men by one thing, and one alone; the means by which the grand objects of desire may be attained. Now this is certain, that the means by which the grand objects of desire may be attained, depend almost wholly upon the political machine. When the political machine is such, that the grand objects of desire are seen to be the natural prizes of great and virtuous conduct—of high services to mankind, and of the generous and amiable sentiments from which great endeavours in the service of mankind naturally proceed—it is natural to see diffused among mankind a generous ardour in the acquisition of all those admirable qualities which prepare a man for admirable actions; great intelligence, perfect self-command, and over-ruling benevolence. When the political machine is such that the grand objects of desire are seen to be the reward, not of virtue, not of talent, but of subservience to the will, and command over the affections of the ruling few; that interest with the *man above* is the only sure means to the next step in wealth, or power, or consideration, and so on; the means of pleasing the man above become, in that case, the great object of pursuit. And as the favours of the man above are necessarily limited—as some, therefore, of the candidates for his favour can only obtain the objects of their desire by disappointing others—the arts of supplanting rise into importance; and that whole tribe of faculties which is expressed by the words intrigue, flattery, back-biting, treachery, &c., are the fruitful offspring of that political education, which a government, in which the interests of the subject many are but a secondary object, cannot fail to produce. (F. F.)

See the article EDUCATION, in the *Encyclopædia*, for the discussion of various questions connected with that subject, and UNIVERSITIES, in this *Supplement*.

EDWARDS (BRYAN), the well-known historian of the *West Indies*, was born at Westbury in Wiltshire, on the 21st May 1743. His father had a small paternal estate, but as this did not exceed L. 100 *per annum*, he found it insufficient for the maintenance of a numerous family, and endeavoured to improve his circumstances by dealing in corn and malt. This hazardous trade proved, as it often does, only a means of more deeply involving his affairs, and he died in 1756, leaving a widow and six children in a very distressed situation. Mrs Edwards, however, had two opulent brothers in the West Indies, the eldest of whom, called Zachary Bayly, possessing a princely fortune, and being of a very amiable and generous disposition, undertook the support and education of young Edwards. He had already been placed by his father at the school of Mr Foot, a dissenting clergyman at Bristol, where he had been taught the elementary branches of education; but for some reason which he never was able to divine, that person was strictly prohibited from initiating him in any branches of classical learning. He gave a species of instruction, however, not usual in schools, and from which his pupil, probably, derived the greatest benefit. He was accustomed to make the boys write letters, or rather essays, on various subjects, such as the beauty and dignity of truth,—the obligations to a religious life,—the benefits of good education, &c. giving them, where it appeared necessary, an outline of the arguments which might be employed on the subject. When the papers were given in, he made such observations as appeared proper, insisting, at least, that they should be correct in point of grammar and orthography. These exercises gave occasion to display the superior talents of Edwards, whose powers of elegant composition already began to appear. He soon became the favourite of his master, who liberally praised these youthful performances, and often transmitted them for the gratification of his parents. They were entirely satisfied; but when the care of his education devolved on his uncle, the agent employed by him at Bristol was much surprised to find an entire deficiency in classical knowledge, and imputing the blame to the master, removed him immediately to a French boarding-school in the same city. It is not said, that he acquired here any great portion of Greek and Latin, but he became master of the French language, and having access to an extensive circulating library, cultivated a taste for reading which adhered to him through the whole of his future life.

In 1759, another uncle, the younger brother of him under whose care he had hitherto been, arrived in England. He, too, was possessed of an ample fortune, became member of Parliament, first for Abingdon, and afterwards for his native town, and set up a splendid establishment in London. He appeared quite disposed to befriend young Edwards, and

Edwards. even took him to reside with him; but the latter observes, that after enumerating his external advantages, he had nothing else to say in favour of his uncle. What the bad qualities were, which drew forth so unfavourable a sentence, we are not informed; but in a few months they separated, and Edwards went out to his other uncle. In this friend he seems to have found every thing he could desire, the most enlightened mind, the sweetest temper, and most generous disposition. To this was added, a truly paternal regard for himself, which was returned with all the warmth of filial affection. His uncle, finding him possessed of literary talents, but deficient in classical acquirements, engaged a Mr Teale, a clergyman, and formerly master of a free grammar school, to reside in his house, and give him the instruction of which he stood in need. This choice proved most acceptable to Edwards; he found in Mr Teale a man of extensive information, and possessing considerable taste in poetry. He viewed him, therefore, as a companion rather than a teacher; but this relation between the tutor and pupil, however agreeable to both, was not favourable for instilling the dry principles of grammar and prosody. A much larger proportion of their time was spent in tasting the beauties of Dryden and Pope, and in laughing at the comic sallies of Moliere. Mr Edwards, upon the whole, acquired, during this period, small Latin and less Greek; but he continued to practise composition, both in prose and verse, and the two companions sent occasional pieces to the colonial newspapers.

The time was now coming when Mr Edwards's talents were to be exercised in a wider sphere. His uncle dying, bequeathed to him his property; and, in 1773, he became heir to the much larger estate of Mr Hume, also of Jamaica. His wealth and talents united, now entitled him to take a lead in the political concerns of the island. In 1784, he published "*Thoughts on the Proceedings of Government, respecting the Trade of the West India Islands with the United States of America.*" This was followed by a speech delivered at a free conference between the Council and Assembly at Jamaica, held on the 25th of November 1789, on the subject of Mr Wilberforce's propositions in the House of Commons concerning the Slave Trade. It was in 1793, however, that he published his great work, on which he had been many years engaged, entitled *History, Civil and Commercial, of the British Colonies in the West Indies*, 2 vols. 4to. He begins the work by giving a view of the original inhabitants of the West Indies, their manners, institutions, and the means by which they have been so entirely exterminated. This was followed by a sketch of the revolutions through which these islands have passed since the first European invasion. He gives next a geographical and statistical description of each particular island. He treats finally, at great length, on the government, social state, and above all, the commerce, of this remarkable region. In the course of the discussion, he enters fully into its relations with the African coast and the Negro slave trade. Mr Edwards, as a great and long-resident proprietor, was almost inevitably led to be a supporter of this traffic. He reasons, however, in a liberal and candid manner on the question, and does not even attempt to deny the extent of the evils with which it was accompanied. He only insists that these evils have been overrated; and that Great Britain, by renouncing it while it was still prosecuted by the other nations of Europe, would ruin her own colonies without doing any thing to improve the condition of the Africans. In 1796, he published, in one volume 4to, a *History of St Domingo*, an island which had excited a deep interest, in consequence of the insurrection of the slaves, and the consequent establishment of an independent Negro government. In 1801, a new edition of both these works was published, in 3 vols. 8vo, under the general title of *History of the West Indies*. A fifth edition has just issued from the press. (1819.) When Park returned from his celebrated journey, Mr Edwards, from his oral information, drew up a report of it, which was submitted to the African Society, and published in their *Transactions*. Mr Park afterwards incorporated the greater part of this into the general narrative of his *Travels*, in preparing which he availed himself much of the assistance and suggestions of Mr Edwards. It has been currently said, that this narrative was entirely written by Mr Edwards; but as this assertion has been pointedly contradicted by Park, who has elsewhere shown respectable talents for composition, it can only be understood in the limited sense which has now been stated. It appears, however, that Mr Park was induced, by Mr Edwards's influence, to give rather a more favourable view of the trade in slaves than reflection afterwards led him to sanction. Edwards.

Mr Edwards, after his removal to England, took up his residence at Polygon, near Southampton; and, in 1796, became Member of Parliament for the borough of Grampound, which he continued to represent till his death, which took place on the 15th July 1800. He left a short narrative of his life, which was prefixed to the edition of his history published in 1801. (B.)

EDWARDS (Jonathan), a celebrated American metaphysician and divine, was born October 5, 1703, at Windsor, in the province of Connecticut. His family had originally emigrated from England in the reign of Queen Elizabeth. His father, Mr Timothy Edwards, was a clergyman of great piety and respectability, and by his mother he was grandson of Mr Solomon Stoddard, a noted and zealous divine of Northampton. Jonathan was accordingly reared in the bosom of Puritanism, and all his ideas were early imbued with the cast of thought, which was native to the stock from which he sprung. There was something, indeed, not a little singular in the prevailing character of religion in America in those days. A *conversion* seems to have been a regular era in a man's life, which could be fixed down to a date, as much as his coming of age or being married. A very curious document remains of Jonathan's conversion, the whole steps and progress of which he has detailed for the behoof of his children; and it is a document which, even amidst all its frequent weakness and extravagance, impresses us with a high sense of the genius and of the worth

of this remarkable man. We cannot avoid giving our readers a little insight into it, especially as it contains some passages of deep feeling and sensibility, which form a striking contrast to the controversial hardness of his writings. It is full of bursts of tenderness; and even while the subjects of his earliest meditations were the same dark doctrines, in their most tremendous form, which he afterwards defended so ably by the help of his mature reason,—amidst all the gloom which naturally surrounds them, they seem to have left upon his mind no sentiments that were not gentle and charitable. At the same time, this document affords us a distinct proof that such doctrines take their origin, in a great measure, in peculiar circumstances of society, or of the individual mind; and since they were quite as fully impressed upon Edwards before he was capable of any profound reasoning upon them as afterwards, the presumption is, that his early prepossessions came strongly in aid of his later conclusions.

It was in the midst of these youthful musings that he acquired a full and firm persuasion of tenets which we will own scarcely seem to us, to be either so "lovely," or of so "good report," as the more natural sentiments of his *unconverted* state, which he gave in exchange for them. "I had a variety (says he) of concerns and exercises about my soul from my childhood; but had two more remarkable seasons of awakening, before I met with that change by which I was brought to those new dispositions, and that new sense of things that I have since had. The first time was when I was a boy, some years before I went to college, at a time of *remarkable awakening* in my father's congregation. I was then very much affected for many months, and concerned about the things of religion," &c. This state of mind, however, rather passed off; but, in his last year at college, he was visited by a severe sickness, which made him form many wise and holy resolutions, which he was afterwards for the most part enabled to keep. So far well, but now follows the grand proof of his conversion: "From my childhood up," he says, "my mind had been wont to be full of objections against the doctrine of God's sovereignty, in choosing whom he would to eternal life, and rejecting whom he pleased, leaving them eternally to perish, and be everlastingly tormented in hell. It used to appear like a horrible doctrine to me. But I remember the time very well, when I seemed to be convinced and fully satisfied as to this sovereignty of God, and his justice in thus eternally disposing of men according to his sovereign pleasure. But never could give an account how, or by what means, I was thus convinced, not in the least imagining in the time of it, nor a long time after, that there was any extraordinary influence of God's Spirit in it, but only that now I saw further, and my reason apprehended the justice and reasonableness of it. However, my mind rested in it, and it put an end to all those cavils and objections that had till then abode with me all the preceding part of my life. And there has been a wonderful alteration in my mind, with respect to the doctrine of God's sovereignty, from that day to this, so that I scarce ever have found so much as the rising of an objection against *God's sovereignty in the most absolute sense, in showing mercy to whom he will show mercy, and hardening and eternally damning whom he will.* God's absolute sovereignty and justice, with respect to salvation and damnation, is what my mind seems to rest assured of, as much as of any thing that I see with my eyes," &c. This doctrine continued through all Mr Edwards's life, in peculiar favour with him; and he employs the whole resources of his dialectics to support it, with a full conviction that he was thereby glorifying God, and performing an important service to mankind.

In this document of Mr Edwards's early opinions, we have said that, amidst all their horrors, there are many intimations of the natural fineness and sensibility of his spirit. The following passages are remarkably beautiful, and have about them a tone almost of pastoral or rather scriptural poetry: "Not long after I first began to experience these things, I gave an account to my father of some things that had passed in my mind. I was pretty much affected by the discourse we had together; and when the discourse was ended, I walked abroad alone, in a solitary place in my father's pasture, for contemplation. And as I was walking there, and looked up on the sky and clouds, there came into my mind so sweet a sense of the glorious majesty and grace of God, that I know not how to express..... God's excellency, his wisdom, his purity and love, seemed to appear in every thing; in the sun, moon, and stars; in the clouds and blue sky; in the grass, flowers, trees; in the water, and all nature; which used greatly to fix my mind. I often used to sit and view the moon for a long time, and so, in the day-time, spent much time in viewing the clouds and sky, to behold the sweet glory of God in these things; in the mean time, singing forth, with a low voice, my contemplations of the Creator and Redeemer...... I used to be a person uncommonly terrified with thunder; and it used to strike me with terror, when I saw a thunderstorm rising; but now, on the contrary, it rejoiced me. I felt God at the first appearance of a thunderstorm, and used to take an opportunity at such times to fix myself to view the clouds, and see the lightnings play, and hear the majestic and awful voice of God's thunder," &c. These confessions have let us already into the inside of Edwards's mind, and there is no need to return upon them, while we pursue the account of his studies, life, and writings. There is a poetry and grandeur in some of his passages of this sort, which show a moral sublimity of genius in the midst of enthusiastic reveries, often, in inferior minds, more productive of dark and disorderly sentiments than of sound and elevated piety. When he comes, however, to reason on his theological or philosophical tenets, he is no longer either an enthusiast or a poet; for he then proceeds with all the pertinacity and ingenuity of a hard-headed special-pleading lawyer.

He went young to Yule College, and so early as his thirteenth year had read Locke *On the Human Understanding*, with great delight and profit. He had a great taste for natural philosophy, but the moral and divine sciences were his chief

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object; and after a long residence at college, during which time he prepared himself assiduously for the ministry, he was in due form licensed to preach. In August 1722, he was invited to preach to the English Presbyterians at New York, where he continued with approbation above eight months; but as this society was too small to maintain a preacher, he returned, in the year 1723, to his father's house at Connecticut, where, for some time, he applied to his studies with much industry and perseverance; and this severe application became habitual to him, although he was of a delicate constitution. In the spring of 1724, having taken his master's degree, he was appointed tutor of Yule College, being then in his twenty-first year, an office which, notwithstanding his youth, he filled for two years with great success and reputation. In September 1726, he received an invitation from the people of Northampton in Connecticut, to become assistant to his mother's father, Mr Stoddard, to whom he was ordained colleague in his twenty-fourth year, and continued pastor of this congregation till the year 1750. During this time he married, had many children, and wrote several pious and useful treatises, chiefly suggested by the events of the times; such as his "*Faithful Narrative of the Surprising Work of God, in the Conversion of many Hundred Souls in Northampton*" (for these, as his biographer * tells us, were remarkable times for the out-pouring of God's Spirit); but particularly a sensible and useful treatise on *Religious Affections*, in which he endeavoured to restrain the extravagance and fanaticism into which, under these strong impressions, the religion of his flock was but too apt to run. He was a most faithful and conscientious minister, but at last fell under the odium of his people, from no other cause but his anxiety for their spiritual interests. They appear, indeed, to have been a very stiff-necked generation, full of absurd whimsical vagaries on the subject of religion, but at the same time with very little of its spirit in their lives and conversations. They had all a voice in the election and continuance of their clergyman, and they were very ready to seize any opportunity to show their power. Mr Edwards discovered that some licentious books had got among the youth of his congregation; a fact as to which he wished some investigation to take place; and this was the first point upon which his people flew off from him. There was afterwards another point about the administration of the Holy Communion. His grandfather Mr Stoddard, it seems, had a notion, that the administration of the sacrament was a moment which the Divine Spirit was much disposed to seize for the conversion of sinners; and that, therefore, the most notorious sinners were to be without scruple admitted to that holy ordinance, in the hope that this conversion would fall upon them. The result of this precious notion was, that the utmost licentiousness, mingled as it was with wild religious fancies floating in every brain, began to prevail among the people. When Mr Edwards, on his grandfather's death, got the entire charge, he endeavoured to make a change in this particular. But the outcry against him was loud and overbearing. Even his brethren of the clergy tamely gave way to it; and this excellent, able, and pious clergyman was thus driven away by the misguided flock, for whom he had laboured assiduously for twenty-four years; and at an advanced period of life, with a wife and a large family, was thrown upon the world, and the care of Providence.

His next position was at Stockbridge, in the western part of Massuchusetts Bay, where he was put at the head of a mission for converting the Indians. He was not enabled to do much as a missionary, but here he had a great deal of leisure, which he employed in writing his principal works. It was now he completed his chief treatise, on the subject of free-will; concerning the rapid execution of which we have the following information in the Reverend Sir Henry Moncreiff Wellwood's very interesting *Life of Dr Erskine.*—"It was not till the month of July 1752, that he appears to have resumed his studies on the subject of free-will; for on the 7th of that month he writes Dr Erskine, that 'he hoped soon to be at leisure to resume his design;' and gives him another sketch of the plan of his book, in which, though there be nothing new, there is more detail than in that which he had formerly sent him. Whatever opinion (continues this able writer) may be held with regard to Mr Edwards's argument, it must appear astonishing to those who are capable of appreciating the difficulty of his subject, that, in nine months from the date of this letter (on the 14th of April 1753), he could write Dr Erskine, that he had almost finished the first draught of what he originally intended; though he was under the necessity of delaying the publication till he knew the result of proposals which he had circulated for printing his book by subscription. His book was published in 1754, and though he had made some progress in preparing his materials before he left Northampton, was certainly written, and nearly completed, within the time ascertained by the two letters referred to, and must be admitted to convey a very striking idea, both of his mental resources, and of his literary ardour."

In 1757, on the death of Mr Aaron Burr, Mr Edwards was chosen President of New Jersey College. He had been here, however, a very short time, when he was carried off on March 22, 1758, in the fifty-fifth year of his age, by the small-pox. This disease was, at that time, raging in the neighbourhood. Mr Edwards, who had never had it, proposed to be inoculated, which his physicians approved of. He had the disease favourably, but a secondary fever set in, and by reason of a number of pustules in his throat, the obstruction was such that he could not

* This primitive piece of biography, from which all our quotations are taken, is prefixed to a volume of sermons published after Mr Edwards's death. Its author is not mentioned. The edition from which we quote is printed at Edinburgh by Alexander Jardine, 1799.

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swallow the necessary medicines, and the fatal result was what we have stated. The character of Mr Edwards is that of a very primitive, self-mortified, simple, and amiable man, and affords a strong proof of the power of genuine Christian piety upon the heart in spite of the most dark and awful tenets. He was solely occupied with his professional duties and his theological studies, insomuch, as is mentioned with inimitable simplicity by the author of his life, "that he was less acquainted with most of his temporal affairs than many of his neighbours, and seldom knew when and by whom his forage for winter was gathered in, or how many milk-kine he had; whence his table was furnished," &c. Mrs Edwards, however, a most valuable and sensible woman, fully supplied his defects in these particulars. We must quote another passage from this piece of biography, which is equal in simplicity, though by no means in any thing else, to some of the exquisite biographies of Isaac Walton. After being informed that he did not permit dancing (he has a sermon against that amusement), we are told that "he allowed not his children to be from home after nine o'clock at night, when they went abroad to see their friends and companions; neither were they allowed to sit up much after that time, in his own house, when any came to make them a visit. If any gentleman desired acquaintance with his daughters, after handsomely introducing himself, by properly consulting the parents, he was allowed all proper opportunity for it, *and a room and fire*, if needed; but must not intrude on the proper hours of rest and sleep, nor the religion and order of the family."

Mr Edwards comes nearer Bishop Butler as a philosophical divine than any other theologian with whom we are acquainted. His style, like Butler's, is very much that of a man thinking aloud. In both these authors the train of thinking in their own minds is more clearly exhibited to us than, perhaps, by any other writer; while they show us, with great truth and distinctness, what their notions are, and how they came by them, with very little concern about the form of expression in which they are brought out. Butler, however, had a larger mind than Edwards, and was by no means so much of a special pleader. He may be, therefore, less acute, but he is more comprehensive, and gives fairer play to every opposing argument. We do not mean here to enter into any of Edwards's speculations. Both on the subject of Original Sin, and on the Freedom of the Will, he seems to us to unite a great deal too closely the views which originated, as we have seen, in no small degree, amidst his early reveries, with the infallible discoveries of divine revelation. Our notion is, that in all discussions on such subjects which have hitherto appeared, the speculatists have forgotten how little a part either of the history or the nature of man we are, in fact, acquainted with; and how ready we ever are, in laying the foundations of our theories, to place a tortoise beneath the elephant. The whole difficulty, for instance, on the freedom of the will, turns upon a puzzle in the idea of cause and effect. Perhaps this idea is far from being precise in our minds (Mr Edwards uses it very loosely in his speculations), and yet we do not scruple, in our reasonings upon it, to draw the most positive inferences from the assumptions which we lay down. We suspect, for our parts, that the true and accurate notion of causation always involves the idea of volition, and, in that supposition, to ask for the cause of volition itself is absurd. It may be very true, that we cannot *will* to do any thing without previous *thought* or *motive*; neither can we *think* without previous *existence*. But is our *existence* the *cause* of our *thinking*? Just as much as our *thinking* is the *cause* of our *willing*. We are far, however, from wishing to add our own crude conceptions to those which have been piled up upon this subject from the beginning of time to the present hour, without, we believe, doing the slightest service to the cause of moral and religious truth, or doing any thing, in short, except affording an exercise for ingenuity, and too often a handle for the most uncharitable rancour and presumptuous absurdity. Mr Edwards, with all his great powers, has, accordingly, we apprehend, done but little good to the world,—we mean as a philosopher,—for he did much good in his own day, while he was living the life of a zealous and faithful Christian minister. But it is "thus we play the fools with the time; and the spirits of the wise sit in the clouds and mock us." Exalted above all the folly of *human* wisdom, the spirit of this truly good and pious man is now, it may be, disposed to regard with some such sentiment many of his own former most severe and laborious speculations, which were carried on in the serious belief, that if "the knots of Calvinism were trimmed off, or its doctrines, in the whole length and breadth of them, were not rigidly maintained, a man could nowhere set his foot down with consistency and safety, short of Deism, or even Atheism itself, or rather universal Scepticism!"

Edwards's works consist of several volumes of sermons, printed at various times, and often reprinted in this country as well as in America. Besides these he wrote, 1. *A Treatise concerning Religious Affections*, 1746, 8vo. 2. *An Account of the Life of the Reverend David Brainerd*, 1749, 8vo. 3. *An Inquiry into the Qualifications for full Communion in the Visible Church*, 1749; intended as a vindication of his principles in the matter which occasioned his dismission from Northampton. 4. *A careful and strict Inquiry into the Modern Notion of that Freedom of Will, which is supposed to be essential to Moral Agency*, 1754. 5. *The great Christian Doctrine of Original Sin defended; containing a Reply to the Objections of Dr John Taylor*, 1758. 6. *A History of Redemption*. 7. *Miscellaneous Observations on Important Theological Subjects*. London, 1793. 8. *Remarks on Important Theological Controversies*. Ibid. 1796. Some of these were posthumous, as were a few other tracts of less importance written by him. (v. v.)

EGYPT.

Latest Publications.

SECT. I. Introductory view of the latest Publications relating to Egypt.—II. Pantheon.—III. Historiography.—IV. Calendar.—V. Customs and Ceremonies.—VI. Analysis of the triple Inscription.—VII. Rudiments of a Hieroglyphical Vocabulary.—VIII. Various Monuments of the Egyptians.

SECTION I.—*Introductory view of the latest Publications relating to Egypt.*

The antiquities and literature of Egypt have always been considered, on account of the very early progress which its inhabitants had made in the arts of civilised life, as objects of the highest interest and curiosity, though involved in inextricable obscurity; but we have acquired, in the course of the last twenty years, and are still continuing to acquire, such additional information respecting them, as promises, if completely confirmed by future researches, to establish the whole of our knowledge respecting this marvellous country on a new and a sure foundation.

A considerable portion of the labours of the French Institute at Cairo has been communicated to the public in a work of unexampled splendour and magnificence, the ponderous *Déscription de l'Egypte*, about one half of which only has hitherto appeared. Many of the monuments brought by the British army to England have also been accurately and elegantly engraved in this country; and a variety of travellers of different nations have published accounts of their numerous observations and discoveries made in Egypt and in its neighbourhood.

The first in order of these, that it will be necessary to notice, is Mr William Hamilton's volume, entitled *Remarks on Several Parts of Turkey*. Part I. *Ægyptiaca*, 4to, London, 1809. It appears that, the power of the French in Egypt having terminated in September 1801, the temporary possession of the country was at first divided between the Turks, the Mamelukes, the Arabs, and the English, a circumstance which afforded some convenience to a European traveller, although it had no tendency to enlarge the sphere of his observations. In the beginning of October, Captain Leake and Lieutenant Hayes were appointed, by General Hutchinson, to make a general survey of Egypt, and of the country beyond it, if it should be found practicable to penetrate further south. Mr Hamilton, who had resided at the British head quarters for the purpose of corresponding with Lord Elgin upon the events of the war, was now at liberty to join these gentlemen in their expedition; and the various information which, with their assistance, he collected, respecting the remains of the ancient Egyptian magnificence, bears ample testimony to the good taste, as well as to the industry and accuracy of the whole party. On account, however, of the disturbed state of the country, and of a multitude of other difficulties, both moral and physical, they were unable to proceed further south than a few hours' journey beyond Syene, to a village called Debôd, opposite to which they observed the ruins of Barembre, the Parembole of the ancients; and among these they found a Greek dedication of a temple to Isis, by Ptolemy Philometor and his queen. They collected, also, a variety of inscriptions from other parts of Egypt, to which they added drawings and descriptions of the remains of the buildings to which they belonged; and, at Alexandria, in particular, Mr Hamilton was enabled, in company with some other gentlemen, by examining the inscription on Pompey's pillar, in different positions of the sun, to ascertain the name Diocletian, as that of the emperor to whom it was dedicated; and to find some traces of the name of Pompeius, who has been shown by Mr Quatremere to have been a prefect of Egypt under that emperor. It is, however, to be regretted, that the Coptic inscriptions, which are sometimes found mixed with the Greek, have not been more generally copied by travellers, since it is only among these that we can hope to find any traces of the vernacular nomenclature of the Egyptian mythology; although, from the few specimens which have been hitherto examined, it seems probable that the introduction of the Coptic character was only coëval with that of Christianity.

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Mr Badia, a Spaniard, who is supposed to have been sent into the east on the business of the French government, has published two volumes of his *Travels*, under the name of *Ali Bey*. They contain some documents relating to the recent history and present state of Egypt, but very little information respecting its antiquities.

Mr Legh and Mr Smelt visited Egypt in 1812. They extended their tour as far as Ibrim, and observed, in their way, many remains of ancient buildings, some of which were in perfect preservation; but they were unable to attain the second cataract, which was said to be three days' journey further south. At Cairo, they paid a visit to the Pasha Mohammed Ali, under whom they "found Egypt in a state of greater tranquillity than it had enjoyed for many years, a change for which it is entirely indebted to the vigorous administration of the present Pasha." It appears that soon after the English had evacuated the country, the Mamelukes were driven by their rivals into Upper Egypt; they, however, regained a momentary influence in Cairo after the deposition of Mohammed Pasha by his Albanian soldiers; but they were soon again expelled by these same troops, with whom they had formed a temporary alliance; and the present Pasha, Mohammed Ali, who had been formerly captain of a pirate boat in the Archipelago, was made chief of these insurgents, whom, according to Ali Bey, he was at first obliged to indulge in all their licentiousness; but he promised that, in a few years, it should be safe to walk the streets of Cairo "with both hands full of gold," and Mr Legh found that he had completely kept his word. He was then occupied in prepara-

tions against the Wahabees, and his intercourse with England materially assisted him in his various pursuits.

Besides some other interesting antiquities which he collected, Mr Legh obtained in the island of Elephantine a few Thebaic manuscripts, written with a chalybeate ink on skins of leather, which he has deposited in the British Museum. They appear to be principally conveyances of estates, dated at Cyrshe or Gyrshe, a place 50 or 60 miles beyond Essouan or Syene; and, though unimportant in themselves, they tend to illustrate the history of the kingdom of Nubia in the middle ages. This kingdom seems to have been almost forgotten by some late travellers and geographers, although it was formerly remarkable for having been, according to an old tradition, one of the first that embraced Christianity, even in the time of the Queen Candace, one of whose servants was baptized by St Philip (Acts, viii.); and who appears to have been one of the immediate successors of the Candace, mentioned by Strabo, as having attacked the province of Egypt, and having been conquered by Petronius in the time of Augustus. The kingdom of Nubia extended as far north as Syene, which continued to be the boundary of the Mussulman power in the tenth century, and probably much later. To the south it originally comprehended Ethiopia, its capital, Meroe, being placed in latitude 17°, on an island in the Nile, or rather on a peninsula formed by its principal branches. Candace had also a palace at Napata, which Pliny makes about 500 Roman miles beyond Syene, and 360 short of Meroe. In the seventh century, the Nubians seem nominally to have been made tributary to the Arabs; but they remained, in fact, almost wholly independent of them in their government, and their religion was entirely subjected to the spiritual direction of the patriarchs of Alexandria. Early in the tenth, the Nubians attacked Syene, not as rebels, but as legitimate enemies. They were, however, repulsed soon afterwards. A little later, we find that George, king of Nubia, was a mediator between the king of Abyssinia and the patriarch, whom he persuaded to send bishops from Alexandria into Ethiopia. In the eleventh century, Solomon, king of Nubia, abdicated in favour of his nephew George, and retired to a monastery, within three days' journey of Syene; whence he was brought by the Saracens to Cairo, and there treated with great attention as a sort of state prisoner. It is also said, that a king Cyriac once raised 100,000 men to assist the Christians against the Mussulmen; but the magnitude of the number renders the whole story more than doubtful. We learn from Hartmann's notes on Edrisi, that Abulfeda in the fourteenth century, and Bakui in the fifteenth, spoke of the Nubians as still Christians; and it seems highly probable that they continued to exercise their religion till about the time of Sultan Selim, in the beginning of the sixteenth century, if not still later; for Vansleb, who was at Siut in 1673, tells us, that the churches were then still entire, though they were shut up, Christianity having become completely extinct for want of pastors. He gives us the names of seventeen bishopricks, which had constituted three provinces; the first province he calls *Maracu*, and attributes to it the bishopricks of *Korta*, *Ibrim*, *Bucoras*, *Dunkala* or *Dungala*, *Sai*, *Termus*, and *Scienhur*; the second province seems to hold a middle place: and, in the third, he mentions *Soper* as the capital of the kingdom, without noticing Nuabah, which is the name given to the metropolis by the Arabic authors. D'Herbelot, who died in 1695, speaks of a patriarch still resident at Dungola, and appointed by the patriarch of Alexandria. There can, at any rate, be little doubt that the "King John," mentioned in the manuscripts of Gyrshe as a Christian, must have been a king of Nubia, and rather a predecessor of the Mek of Dungola, than a Greek emperor, whose authority was probably never acknowledged in this country, and least of all when Egypt was in the possession of the Arabians. (Strabo, Book XVII. Pliny, Book VI. Chap. xxix. *Hist. Byzant.* Vol. XXI. *Ancient Universal History*, fol. Vol. VII. *Modern Universal History*, Vol. I. Vansleb, *Hist. de l'Egl. d'Alexandrie*, Par. 1677, p. 29. D'Herbelot, *Bibl. Orient.* *Narrative of a Journey in Egypt, and the Country beyond the Cataracts.* By Thomas Legh, M. P. 4to. Lond. 1816. *Sepulchral Inscriptions from Nubia*, Archæologia, XIX. p. 169.)

The remains of the churches mentioned by Vansleb were observed, in many parts of Nubia, by Captain Light of the Royal Artillery, covered generally with paintings of scriptural subjects, and not uncommonly appearing to have been originally built for pagan temples. The Pasha of Egypt, he says, "was named as sovereign" of the country, "in all transactions" between Cairo and Assouan; beyond this, as far as Ibrim, which was the extent of his expedition, "the reigning Sultan Mahmoud was considered as the sovereign," though the neighbouring "cashief's power was plainly feared more." At Dakki Captain Light found the name of Hermes inscribed as that of the deity to whom the temple situated there must have been dedicated; and it will be interesting to inquire if any hieroglyphics can still be found on this remarkable edifice, which will bear a similar interpretation. (*Memoirs relating to European and Asiatic Turkey.* Edited by R. Walpole, M.A. 4to. Lond. 1817. P. 402, 465.)

Captain Light has more recently published a separate volume of his *Travels*, 4to, London, 1818. He informs us, that after the expulsion of Mohammed Pasha, two others were elected by the troops to the same dignity, each of whom remained in power a few weeks only. The last of them had appointed Mahommed Ali as his general, to command an expedition against the Mamelukes, but having succeeded in checking the enemy, the victorious general returned to expel and take place of his master. This remarkable person was originally a Thracian; and he has certainly given sufficient proofs of the "vigour" of his character in his transactions with the Mamelukes, with whom he concluded a treaty of alliance against the Wahabees; for when they had sent the stipulated force of 1500 men to co-operate with him, he put to death every man of them in a single morning. He succeeded, however, in rescuing the holy cities from the power of the Wahabees, and the possession of the keys of these cities ostensibly ob-

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tained him the favour and countenance of the Porte, notwithstanding the general insubordination of his proceedings.

Mr Walpole's collection contains also some older papers of the late Mr Davison, who was British consul at Algiers, and accompanied Mr Wortley Montague to Egypt in 1763. Mr Davison discovered, in the great pyramid, a room before unknown, immediately over the chamber which contains the sarcophagus; and he descended the three successive wells, to the depth of 155 feet. He also describes the catacombs of Alexandria, which seem to have been principally employed by the Greek inhabitants of that city. The same volume contains a very interesting account of the customs and manners of modern Egypt, from the journal of Dr Hume.

A considerable addition has been made to our knowledge of the geography of Egypt, by the publication of Lieutenant Colonel Leake's accurate and elegant map of that country, comprehending also a sketch of Nubia, as far as the southern cataract, which appears to be the limit of the existing remains of antiquity. Besides the results of his own personal survey, Colonel Leake has employed the observations of the French astronomers for the determination of the situation of the different places; and, with respect to the remoter parts, he has had the advantage of consulting the manuscript papers of the late lamented Mr Burckhardt, who unhappily fell a victim to a dysentery at Cairo, in October 1817, after having obtained, by a long residence in the country, under the name of Shekh Ibrahim, an intimate acquaintance with every thing, that could have tended to facilitate the further prosecution of his projected expedition, into parts of the continent still more remote. Besides the ruins of Greek churches, scatterred throughout this country, the principal points of Nubia, which are remarked as exhibiting remains of still greater antiquity, are the Parembole of the Itinerary of Antonine, near Debod, and Tzitzi, now Klitzie, both of which had been visited by Colonel Leake and Mr Hamilton; Kardassy or Gartaas; Taphis and Contra Taphis, now Tafa; Kalabshe, the ancient Talmis; Merowan, the ancient Tutzis, near Gyrshe; Pselcis, now Dakki, and Corte, still Korti; Maharraka, supposed to be the Hierosycaminon of the Itinerary, and which may, very possibly, have been the Maracu mentioned by Vansleb as an archbishoprick; Seboua; Hasséya; Derr; Ibrim, the Premnis of the ancients; Ebsámbal, perhaps the Aboccis, with its two temples, still better known by the labours of the active and ingenious Belzoni; Beyllany, or rather Fereyg; Serra, probably Phthuris; Sukkoy, perhaps Cambusis; Samne, not improbably the Acina of Nero's spies; Aamara, possibly Stadysis; and Soleb, not far short of the southernmost cataract, where the author is disposed to place the Napata of the ancients, in latitude about $19\frac{1}{2}^{\circ}$: a situation which would agree very well with the distances of Napata from Syene and from Meroe; but it is impossible to admit that this cataract can be so far south as even 20°, consistently with the testimony of other geographers respecting the latitudes of Mosho and Sukkot; and, indeed, the course of the river is laid down more nearly north and south than the description of Burckhardt requires. We may, however, expect much information on this subject from the observations which have been more recently made in the lower parts of Nubia, by Captain Corry of the Navy, who has visited them in company with his brother Lord Belmore. (*Map of Egypt, 2 Sheets.* Lond. 1818.)

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The *Quarterly Review* has afforded us, in several late numbers, a highly interesting and gratifying detail of the operations and discoveries, which have been conducted in Egypt, by several of our spirited and enterprising countrymen. Among these Mr Bankes has proceeded the furthest south, in the steps of Mr Burckhardt, and has made collections and drawings of a great number of striking remains of antiquity (*Quarterly Review*, No. 31); and he has sent home to this country a variety of statues and bas reliefs, as well as large manuscripts on papyrus, in the epistolographic character. Mr Salt has been indefatigable in his exertions, and he has most fortunately found an assistant of Herculean strength of body, and of proportional energy of mind, in the person of Mr Belzoni. The head called a young Memnon, now in the British Museum, which weighs eight or ten tons, and which is one of the very finest specimens of Egyptian sculpture now in existence, was a joint present of Mr Salt and Mr Burckhardt; and Mr Belzoni has the merit of having conducted the very difficult operation of bringing it down to the Nile. Mr Hamilton has conjectured that it may have belonged to the statue described by Philostratus as a Memnon of great beauty (*Q. R.* No. 36); but the remaining fragment of the hieroglyphical inscription agrees better with the name of another sovereign, apparently of the same family, who is represented in several other magnificent monuments at Thebes and elsewhere.

Captain Caviglia, the master of a mercantile vessel in the Mediterranean, has exerted himself with singular activity and perseverance in examining the interior of the great pyramid of Cheops. After having retraced the forgotten steps of Mr Davison, he succeeded in pursuing the principal oblique passage 200 feet further downwards than it was before practicable, and in discovering at this point a communication with the well, which descends from the floor of the upper chamber. This communication affording him a freer circulation of air, he was enabled to proceed 28 feet further in the passage, when he found that it opened into a spacious chamber, 66 feet by 27, but of unequal height, immediately under the centre of the pyramid, which Mr Salt supposes to have been the place of the THECA, or sarcophagus, mentioned by Strabo as situated at the end of the oblique passage, though at present no sarcophagus is to be found in it. The floor is elevated 30 feet above the level of the Nile, so that the water could never have flowed into this part of the pyramid, to surround the tomb of Cheops, as Herodotus imagined. Some passages leading out of this chamber appear to terminate abruptly, without opening into any others. The dimensions of the upper chamber, which still contains a sarcophagus, are only $35\frac{1}{2}$ feet by $17\frac{1}{4}$, and $18\frac{3}{4}$ high.

In six pyramids which have been opened, the principal passage preserves the same inclination of about

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26° to the horizon: but if this construction was intended to facilitate the observation of the pole star, as has been conjectured, it was at least extremely ill contrived for the determination of time, on account of the very slow apparent motion of that star. In a small pyramid, south of that of Mycerinus, two chambers were found, but both were empty.

Captain Caviglia proceeded to examine a number of detached mausoleums, more or less dilapidated, in the neighbourhood of the pyramids: he found their embellishments chiefly in the style of the Theban catacombs; and they sometimes contained images too large to have been brought in through the doors or windows. Some of the stones with sculptures were placed upside down; and it was conjectured that these might possibly have been portions of the original casing of the pyramids, which is said to have been sculptured, but which is now fallen down.

His next undertaking was the very arduous task of digging away the sand in front of the great sphinx; a share of the expenses of this labour, which amounted to eight or nine hundred pounds, being contributed by Mr Salt and some other gentlemen. The body of the monster is principally formed out of the solid rock; the paws are of masonry, extending forwards fifty feet from the body: between them were found several sculptured tablets, so arranged as to constitute a small temple or chapel, and further forwards a square altar with horns, which seems to have been employed for burnt offerings. Several little lions, painted red, which had been placed on the neighbouring walls, are also among the antiquities which Captain Caviglia has very liberally presented to the British Museum, as a testimony of respect to the nation whose flag had formerly protected him in his voyages.

Mr Belzoni, at his own risk and expense, succeeded, after many fruitless efforts, in discovering the entrance into the second pyramid of Chephren, in which Herodotus had asserted that there were no chambers. The passage, descending at first obliquely from the north side, proceeds afterwards horizontally to the principal and central chamber, which measures 46 feet by 16, and is $23\frac{1}{2}$ high, containing a sarcophagus of granite, with some bones, which, from a specimen brought over by Major Fitzclarence, have been ascertained to be those of a bullock. An Arabic inscription testifies that the pyramid had once been opened in the presence of the "Sultan Ali Mahomet the First, Ugloch," who may possibly have been the Ottoman emperor, Mahomet the First, in the beginning of the fifteenth century. (*Quarterly Review*, No. 36, 37, 38.)

Among the Theban catacombs, Mr Belzoni has discovered six new tombs; the most remarkable of them, which, with all its galleries, is 309 feet long, he calls the tomb of Apis, from having found the mummy of a bullock in one of its chambers. In another apartment was a magnificent sarcophagus of white alabaster, almost as transparent as crystal; and the whole excavation, sculptured and painted in the most finished style of art, was found in the most perfect preservation. Mr Salt observes, that the colours are generally pure and brilliant, but intermixed with each other nearly in the proportions of the rainbow, and so subdued by the proper introduction of blacks, as not to appear gaudy, but to produce "a harmony that in some of the designs is really delicious." Mr Beechey, a son of the celebrated painter, professes himself, in a private letter, to be completely fascinated with the effect of these combinations. "One would think it was in Egypt," he observes, "that Titian, Giorgione, and Tintoret, had acquired all that vigour and magic of effect, which distinguishes them so remarkably from all other painters, in point of arrangement, and principally in the happy disposition of their darks. The new tomb," he continues, "lately discovered here by Mr Belzoni, is about to be transferred by him from Thebes to London. Belzoni has made moulds of every individual object in the tomb; accurate drawings of the whole have been executed on a small scale; the greater part are already finished, and coloured by a young Italian of the name of Ricci, whom Belzoni has employed for that purpose. The tomb will be built on the same scale with the original, and will be seen by candle light; so that the effect cannot fail to be precisely that of the excavation itself."

In Nubia the spirit and perseverance, with which the little band of excavators pursued the attempt to penetrate into the temple of Ebsambal, were not less worthy of admiration. Mr Belzoni and his servant, accompanied only by Mr Beechey, were abandoned on some futile pretence by the Arab workmen whom they had employed, and were unable to procure for many weeks any other food than durra or millet; they had resolution, however, to proceed with their enterprise as manual labourers, and they were at last amply rewarded for their perseverance. In front of the temple there were four colossal statues, sixty feet high, one of which had been thrown down; but it was only after digging for three weeks through 150 feet of sand, that our adventurers succeeded in entering the temple, consisting of fourteen chambers and a great hall, cut out of the solid rock, and ornamented with sculptures superior, in point of execution, to the greater part of those which are found in Egypt; besides eight colossal statues thirty feet high, which are placed in the hall. Mr Belzoni also found at Thebes a colossal head and arm, supposed to have belonged to a Horus; and his lady discovered, during his absence in Nubia, a fine statue of white marble, supporting a ram's head on its knees.

Though Burckhardt's untimely end interrupted his further progress in Africa, yet with respect to Nubia his observations were complete, and he had himself prepared his journals for publication, in a form which does equal credit to his diligence and judgment in observation, and to his candour and good taste in the simple and elegant narration of that which he has observed. He informs us, that the tragedy of the Mamelukes was not confined to Cairo; but that 400 more of them were decoyed out of the mountains near Assouan, and fell victims, together with 260 of their slaves, to the treachery of Ibrahim Bey, the son of the Pasha.

It appears that the Nile, between the first and second cataracts, runs chiefly through a country of

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sandstone, and is navigable throughout this extent; but at the cataract of Wady Halfa, a little above Ebsambal, the sandstone terminates, and the district of granite and other primitive rocks begins, extending a hundred miles further upwards: and in this space the course of the river is interrupted by frequent shallows and small falls. The roaring of the fall at Wady Halfa, sometimes called by way of distinction Jenadel, or the cataract, may be heard at the distance of a mile or two; but the part of the river that falls is only about 20 yards over: there are, however, three falls in succession, and the neighbouring scenery is very romantic. Immediately beyond this country is Kolbe, the principal place in the district of Sukkot, for there is no town of that name: then the island Say, probably the Sai of Vansleb; and, 450 miles above Assouan, according to Mr Burckhardt's reckoning, is Tinareh, in the district of Mahass, the furthest point to which he penetrated, within 15 or 20 miles of the remotest cataract, and a day and a half's journey only from Mosho, by the shortest road. The country through which he passed is supposed to contain a population not exceeding 100,000, and is governed by three Kashefs, who are brothers, and tributary to Egypt, but inclined to favour the Mamelukes, who seem to be pretty firmly established in the neighbourhood of Dongola: Hassan Kashef lives principally at Derr; his brothers further south. At Mahass a series of more than 20 little kingdoms begins, which extend to Sennaar; their kings are independent, but have scarcely the power of life and death; the people are generally slave merchants, and those of Mahass are the nearest that send caravans to Cairo. At Mosho begins the kingdom of Dongola; and near it is the island of Argo, a long day's journey in length, with a brick castle in it. There are many other islands in the course of the river through Dongola, which extends for five days' journey: the country is celebrated for a very fine breed of horses, like the Arabian, but much stronger, and fed, as Bruce observed of the horses in the same neighbourhood, on straw only. The city of Merawe, singularly resembling the ancient Meroe in name, is the metropolis of the Sheygya Arabs, beyond Dongola, and is remarkable for schools, of high reputation, and particularly celebrated for their penmanship. These Arabs ride, like their distant neighbours the Abyssinians, with a toe only in the stirrup.

The languages spoken in Nubia are the Kensy and the Nouba, the former being confined to the northernmost parts of the country: these languages somewhat resemble each other, but they differ essentially from the Arabic, although the people are supposed to be the descendants of Bedouin Arabs, who spread from the East in the middle ages, with the exception of a few of the original inhabitants, who remain about Tafa and Serra, having become Mahometans. However this may be, it is certain that the languages exhibit no traces whatever of any dialect of the old Egyptian; and this circumstance affords a very strong argument in confirmation of the author's assertion, that the Christians had in general been expelled from Nubia before the time of Sultan Selim; the three garrisons of Bosnian soldiers, whom this prince established, in Assouan, Ibrim, and Say, having been sent by the express invitation of one of the rival factions of Arabs, who occupied the country, and remaining still distinct from the rest of the population, and being governed by their own Agas. We can only reconcile these facts with the testimonies in favour of the existence of Christianity in Nubia down to about the same time, by supposing that its extinction must have been gradual, and that the Thebaic language, and the ancient religion of the country, dwindled away by degrees, not "for want of pastors" only, but from the hostility of the Arabian intruders.

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A concise but clear and satisfactory description of the various temples, noticed in Colonel Leake's map, is inserted in Mr Burckhardt's relation: and he conjectures that the order of their antiquity is nearly this: 1. Ebsambal; 2. Gyrshe; 3. Derr; 4. Samne; 5. Ballyane; 6. Hasseya; 7. Seboua; 8. Aamara and Kalabshe; 9. Dakke and Maharraka; 10. Kardassy; 11. Merowau; 12. Debot; 13. Korty; and, 14. Tafa. The small temple at Ebsambal has a head bearing a temple for the capital of its columns, like those at Dendera, but with a lock of hair hanging down on each side. The statues before the great temple, which is supposed to have been dedicated to Osiris, are of remarkably fine forms. In a small temple at Kalabshe there are some good historical sculptures of a victory over the southern countries, beyond Meroe. But the sculptures at Dakke Mr Burckhardt thinks superior to any others of the Egyptian school, and such as might have been considered as fit ornaments for a Grecian building. In a small temple at Samne, there is still an image with the attributes of Osiris, and there are figures of a Paamyles on the walls.

Mr Burckhardt has given us several Greek inscriptions, many of which had been copied by Captain Light a little differently. One of these begins with "*This is* the homage of *Caius* Cassius Celer;" not *Vulsilius*, as it had been read from Captain Light's manuscript. At Maharraka, the writer of one inscription has very benevolently included "the reader" in his petition, for a blessing from "Isis, the goddess with ten thousand names, and from the sun Sarapis." At Kardassy, an inscription dated under the Philips, the successors of the Emperor Gordian, records the munificence of Psentuaxis, who gave to the temple "twenty pieces of gold in his first priesthood, and thirty in his second." A Thebaic tombstone, lying at Assouan, seems to contain only these words: "$\overline{\text{IS}} + \overline{\text{CHT}}$. This day, in memory of the late John Panokaë. Indict. xvi. 15. Mechir 6." In fact, there is scarcely any trace of the old Egyptian language to be found in any existing monument, employed upon any other occasion than for the most unimportant memorials of the most insignificant personages.

An article has lately appeared in one of the French journals, announcing the discovery of a ruined city, situated a few leagues from the Red Sea, by a young French traveller, Mr Cailliaud, nearly in the latitude of Assouan, and called by the Arabs, Sekelle. It has still many temples, palaces, and private houses standing, so that it may in some respects be com-

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pared to Pompeii: the architecture is Greek, with some Egyptian ornaments; several inscriptions prove that it was built by the Ptolemies; and one of the temples was evidently dedicated to Berenice. The situation agrees sufficiently well with that of the ancient city Berenice, so called in honour of the mother of Ptolemy Philadelphus, notwithstanding that several ancient authors agree in describing this city as a port on the Red Sea; for the city may easily have been at some little distance from a harbour bearing the same name: and no other town of any magnitude seems to have existed in the neighbourhood. It was through Berenice, according to Pliny, that the principal trade of the Romans with India was conducted, by means of caravans which reached the Nile at Coptus, not far from the point at which the present shorter route by Cosseir meets the river; and by this channel it is said that no less than L.400,000 of Roman money was sent to India, while merchandises were returned, that ultimately sold for a hundred times as much. Mr Burckhardt seems to have heard some vague reports respecting these ruins; but it was reserved for Mr Cailliaud to obtain ocular evidence of their existence, and of their magnitude.

While so much has been done abroad for the recovery of the lost treasures of Egypt, it appears that no less labour has been silently employed in the pursuit of the investigation at home: and it seems to have been partly with a view to perpetuate the continuance of these efforts, that an association has been formed in London, of which the first and immediate object is merely to insure the preservation, and to facilitate the study of all that remains of Egyptian literature, by making a collection of drawings of all the hieroglyphical inscriptions in existence, and printing them lithographically, in a form most convenient for reference and examination, under the title of *Hieroglyphics, collected by the Egyptian Society.* The plates, which have already been executed, do credit to the manipulation of Mr Ackermann's press, as well as to the extreme neatness and accuracy of the draughtsman who has been employed on them. They can scarcely be said to have been published, as they are only to be distributed among a limited number of subscribers; but as they are to be presented to several public libraries, in different parts of Europe, they may be consulted by the general reader without difficulty.

In the midst of all the zeal and activity displayed by our countrymen who have travelled, or who are resident, in Egypt, it is greatly to be deplored that their attention has not yet been turned to an object, which is paramount to all the rest in its importance, for the substantial advancement of our acquaintance with the ancient history and literature of the country; that is, the recovery of the lost fragments or of some of the duplicates of the "trilinguar," or rather trigrammatic Stone of Rosetta; a monument which has already enabled us to obtain a general idea of the nature and subject of any given hieroglyphical inscription, by pursuing the investigations already carried to an unexpected extent by an anonymous author, whose interpretation was communicated to the Antiquarian Society by Mr Rouse Boughton, together with copies of some fragments of manuscripts which this gentleman had brought from Egypt. (*Archæologia*, Vol. XVIII. p. 61. *Museum Criticum*, No. VI. and VII.) Mr de Sacy, and more especially Mr Akerblad, had made some progress in identifying the sense of the several parts of the second inscription of the stone; but they had scarcely at all considered the sacred characters, and it was left for British industry, to convert to permanent profit a monument, which had before been a useless, though a glorious trophy of British valour.

We must recollect that every analysis of an unknown object of this nature must unavoidably proceed more or less by the imperfect argumentation sometimes very properly called a circle, but which, in such instances, may be more aptly compared to a spiral, or to an algebraical approximation; since, by assuming certain incorrect suppositions, not too remote from the truth, we may render them, by means of a continual repetition of the calculation, more and more accurate, until at length the error is rendered wholly inconsiderable; and in this manner we often satisfy the conditions of a problem, which it would be impracticable to solve by a more direct method. A process thus tedious and laborious, however, loses the greatest part of its interest when the solution is obtained; and it is no longer necessary to explain in detail every step through which it has passed. The deciphering of the Rosetta stone is fortunately in great measure independent of any hypothesis of this kind extraneous to itself; and the Greek text affords at once the first approximation for beginning the process; but, in order to extend the inquiry to other objects, a variety of authorities must be compared and appreciated; we must select from the Greek authors an abstract of the religious superstitions and of the civil ordinances of the Egyptians; but it will be necessary, in making this selection, to have some regard to the results which have been obtained from an examination of the principal hieroglyphical monuments still extant, in order that we may avoid the confusion, which would be the necessary consequence of adopting indiscriminately the whole mass of contradictory matter, which various mythological authors have collected or invented upon the subject; and considering how absurdly and monstrously complicated the Egyptian superstitions really were, it becomes absolutely essential to separate that which is most fully established, or most generally admitted, from the accidental or local varieties, which may have been exaggerated by different authors into established usages of the whole nation, and still more from those which have been the fanciful productions of their own inventive faculties. Unfortunately, by far the greater number of the existing monuments of Egypt are of a mythological nature; so that their pantheon, or rather pantherion, acquires an interest altogether foreign to its real character, on account of the utility of a general knowledge of the subject, in developing the nature of the language employed. The accounts, which have been preserved, of the customs and civil ordinances of the country, are still more discordant than those which relate to their deities; but they may still in some instances be illustrated from monuments which remain in existence. Respecting the early history

and chronology of Egypt, we can do little more than appreciate the various degrees of plausibility of the different fables that have been related, and the comparative credulity of the authors who have appeared to believe in them; for hitherto no hieroglyphical records have been discovered, which can afford as much assistance in this department of the investigation; though it is by no means impossible that a continued series of the sovereigns of Egypt, from the earliest times, may have been chronicled in more than one of the innumerable multitude of inscriptions hitherto uncopied and unexamined.

SECTION II.—*Pantheon of Egypt.*

In the selection of authorities respecting the principal deities worshipped by the Egyptians, it will be most convenient to consider the respective personages in their chronological, or rather genealogical order, as far as any evidence can be obtained to ascertain their places in the mythological system.

1. AGATHODAEMON, *Cneph,* or *Chnuphis,* appears to be the oldest representative of the divine power admitted by the Egyptians, although his attributes are not distinctly ascertained, except as the parent of Phthah, whose origin is referred, in the works of the spurious Hermes, to an egg of *Cneph* or *Emeph,* which is perhaps the Coptic IHHNIFI, *genius of spirit.* Even before this Cneph, we are told of the existence of an *Eicton* or *Icton,* which has been supposed to mean IHHTHO, *genius of the whole world;* but this seems to have been a sort of chaos, and the personification is not generally admitted. Eusebius makes Cneph distinctly synonymous with Agathodaemon; and this interpretation seems to identify the term with the *Cnuphis,* of whom Strabo mentions a temple in Elephantine; since IHHNUFI would naturally mean *good genius,* the word NUFI occurring frequently in other compounds. In a Greek inscription lately brought to the British Museum, the emperor Nero is called the "good genius" of the world, and the winged globe hovering over the inscription seems to be allusive to this piece of flattery: but the Chnuphis or Chnumis of the amulets of later times is a serpent or a dragon raising itself on its tail, having rays about its head, and surrounded with stars. The name of Agathodaemon is inserted by Manetho among the fabulous kings, immediately before Cronus.

2. The same authority attributes a still higher antiquity to PHTHAH, whom it places as the first of the fabulous kings of Egypt; and he is universally considered as the great ancestor of the other deities, and is especially called the father of the sun, as we learn from various chronologers, and from Callisthenes and others. He seems to have been a personification of the creative, and perhaps of the generative power, designated under the character of a workman, or an architect. He is sometimes compared to Prometheus, as the discoverer of fire: but Hephaestus or Vulcan is his common representative in the Greek and Roman mythology; although it must always be remembered, that BETWEEN THE IMAGINARY PERSONAGES OF DIFFERENT NATIONS THE IDENTITY MUST NATURALLY BE ACCIDENTAL AND IMPERFECT. Cicero and Eusebius mention Phthah as the same with Vulcan; and Eratosthenes, on the authority of the Egyptian priests, interprets MOEPHTHA, *Philephaestus,* or *loving Vulcan,* which in Coptic would be exactly expressed by MAIPHTHAH, as MAISGN is *loving a brother.* Mr Akerblad quotes, from a Coptic sermon of Sinnethi, the words, "Hephaestus, who is Ptah," and this remarkable passage proves, as he justly observes, how much Jablonsky was mistaken in his orthography of *Phthash,* on which he founded one of his fanciful etymologies.

3. NEÏTH, the Minerva of the Egyptians, had a celebrated temple at Saïs, in which was the well known inscription on the goddess of universal nature, whose offspring, in the translation of the inscription, as preserved by Proclus, is said to be the sun. It seems therefore natural to call Neïth the wife of Phthah; as Plato also observes, that arts were invented by Vulcan and his wife; but we are told that Neïth is to be considered as both male and female. The name is mentioned by Plato as synonymous with Minerva, and Eratosthenes explains Nitocris, Minerva the victorious.

4. RE, or PHRE, *the Sun,* otherwise called *On,* is mentioned by Manetho as the son of Vulcan. He married Rhea, and having discovered her infidelity, condemned her to bear no offspring on any day or any night of the whole 360 that then made the year. Plutarch says that he was represented by a young child rising out of a lotus; but this emblem is more probably attributable to Horus, who is another of the forms of the solar power, and is sometimes improperly confounded with Apollo. The word *Phre* is often found in Greek letters on the amulets, accompanied by emblems of the sun.

5. RHEA, the wife of the Sun, may perhaps have derived her name from *Re;* she appears to be identical with the *Urania,* or female Heaven, of Horapollo, the Coptic PHE being feminine. Jablonsky makes Rhea the same with Athor, but he adduces no sufficient authority for the opinion. She is said to have been familiar both with Cronus and with Thoth; and Diodorus calls her the wife and sister of Cronus.

6. IOH, *the Moon.* Plutarch tells us that Hermes played at dice with the Moon, probably as presiding over the calendar, in order to gain a time for the birth of Rhea's children, and to evade her husband's curse; so that the Moon must be considered as one of the oldest deities. The Egyptian name being masculine, the Moon can scarcely have been worshipped as a goddess; and whatever relation may have been imagined to exist between Isis and the lunar influence, the two deities were certainly not identical.

7. APOPIS, a brother of the Sun, is mentioned by Plutarch as having made war against Jove. But the Jupiter of Manetho stands much later in the list, the order being Vulcan, the Sun, Agathodæmon, Cronus, Osiris with Isis, * *, Typhon, Horus, Ares, Anubis, Hercules, Apollo, Ammon, Tithoes, Sosus, and Jove; the last nine being denominated semigods.

8. CRONUS, or *Saturn,* is only known from his connexion with Rhea, the wife of the Sun. His

Pantheon. character probably bore some relation to a personification of Time and Antiquity.

9. Thoth, *Theuth*, or *Taaut*, one of the most celebrated of the Egyptian deities, is sufficiently identified with Hermes or Mercury, by the testimony of a variety of authors. Diodorus mentions him as the scribe, or secretary, and privy counsellor of Osiris. He is generally considered as the inventor of letters, and of the fine arts. Plutarch and Horapollo observe, that he was typified by the ibis, which was sacred to him. Plutarch also says, that he had one arm shorter than the other.

10. Osiris, properly Oshiri, meaning in Coptic *energetic*, or *active*, which is precisely one of Plutarch's interpretations of the name, was the deity most universally adored throughout Egypt, and possessing the principal attributes of Bacchus, Adonis, and Pluto; besides being often compared to the Nile, and sometimes to the Sun. He was genealogically considered as the son of the Sun and of Rhea: at his birth, on the first of the supplementary days of the calendar, a voice was heard, proclaiming that he was Lord of all. He married his sister Isis, and, according to Diodorus, left her to govern his kingdom during his military expeditions, resembling those of Bacchus; being accompanied by Pan, Hercules, and Macedo, having a ship which was the prototype of the Argo of the Greeks, with Canopus for his pilot. He was at last treacherously shut up alive in a coffin by Typhon, aided by seventy two conspirators, together with an Ethiopian queen Aso. The coffin, being thrown into the Nile, was carried to one of its mouths, and there left on shore; it became afterwards inclosed in the trunk of an erica, which grew round it, and which constituted one of the columns of King Malcander's palace: but the body escaped from its confinement, and was found by Typhon as he was hunting: he divided it into fourteen parts, which were afterwards found, scattered in different places, by Isis, and buried separately. Osiris, however, returned from the dead, to console his wife, and to conduct the education of his son Horus. There was a mystery in his identification with Pluto, of which the old authors affect to speak with reverence. His dress was generally white, but sometimes black. He is represented as carrying a whip, which is supposed to be intended for the punishment of Typhon. Plutarch says, that he is typified by a hawk, and denoted hieroglyphically by an eye and a sceptre.

11. Arueris, a twin-brother of Osiris, and, like him, the son of the Sun and of Rhea, was born on the second supplementary day. He is also called the elder Horus, and is considered by some of the Greeks as their Apollo.

12. Typhon, the spurious son of Rhea and Cronus, was born on the third supplementary day, and married his sister Nephthe. He is characterized by a red colour, and is supposed to have been a personification of the effects of scorching heat. He is also compared to the earth's shadow, as causing eclipses of the moon. The celestial habitation of his soul was supposed to be in the Great Bear. According to Plutarch, his Egyptian names were *Seth*, *Bebon* or *Babyn*, and *Smy*; the word Typhon being apparently of Greek origin. Pantheon.

13. Isis, Isi, or Esi, was supposed to be the offspring of Thoth and Rhea, born on the fourth supplementary day; she was also sometimes called the daughter of Prometheus. She is generally compared to Ceres, or the Earth, and is made the deity of fertility and of maternal love. She was also esteemed analogous to Proserpine, as the queen of the lower regions, and the wife of Pluto; thus she is called, by Aristides, " the saviour and conductress of souls;" and, in some Roman inscriptions copied by Zoega, she is made " the guardian of the ashes of the dead." Horapollo says, that her head was sometimes adorned with vulture's plumes; but Herodotus tells us, that she was represented with cow's horns, like Io; other authors however say, that, after Horus, in revenge for his father's death, had made Typhon prisoner, Isis imprudently set him at liberty, and Horus, therefore, tore the regal diadem from her brow, but that Thoth or Hermes substituted for it a helmet made of a bullock's head. Her soul was supposed to have its residence in the Dog star, the Sothis of the Egyptians. Her dress was of many colours. She is sometimes compared to the moon; but this idea appears to be foreign to the oldest mythology, as well as to the genius of the Egyptian language. She has also been somewhat arbitrarily confounded with Minerva by Plutarch, in speaking of the inscription of the temple of Saïs, which confessedly related to the Egyptian Minerva, who was indisputably the goddess Neïth; although, in consequence of this inattention, the " robe" mentioned in the inscription has been called the " robe of Isis," and the expression has been almost proverbially employed as denoting mystery and secrecy.

14. Nephthe, rather than *Nephthys*, the spurious daughter of Rhea and Cronus, was born on the fifth supplementary day. She is sometimes called by the Greeks *Teleute*, that is, consummation; and sometimes Venus and Victory. She is mentioned by Firmicus as the sister and companion of Isis; and Plutarch says, that the face of Isis was sometimes represented on the sistrum, and sometimes that of Nephthe.

15. Thueris, a concubine of Typhon, is only noticed as having been pursued, on her way to visit Horus, by a huge snake, which was killed by Horus's people.

16. Bebon, who is sometimes confounded with Typhon, is also mentioned as one of his companions.

17. Ares is inserted among the fabulous kings of Manetho. Vettius Valens says, that the planet Mars was called by the Egyptians *Artes*; and Cedrenus makes the name *Ertosi*. Herodotus tells us, that Mars was worshipped at Papremis.

18. Somus, or *Shom*, was probably the personage called the Egyptian Hercules by the Greek writers. Thus, the great Etymologicon has *Chon* for this deity, and Eratosthenes writes his name *Sem*, both of these having been probably intended to express the Coptic jom or sjom, *strength*, which seems sometimes to have been written jem or sjem. Diodorus mentions this Hercules as a general of Osiris, whom he

Pantheon. left behind with Isis. He is said to have been killed by Typhon, but to have been revived by the smell of a quail. Herodotus asserts, that the word Heracles is originally Egyptian; but in this, as in many other instances, his interpreters must have misinformed him, perhaps from misunderstanding his questions; for his Egyptian etymologies are almost uniformly erroneous. Thus, when the priests had shown him, or rather Hecataeus, whose original story he seems to have copied and disfigured, the statues of 341 successive generations of high priests, who were neither gods nor heroes, but each a PIROMIS, the son of PIROMIS; he tells us, that PIROMIS means *beautiful and brave;* while, in fact, the literal sense of PIROMI, in the modern Coptic of Lower Egypt, which is simply *a man*, restores to the observation of the priests an intelligible and consistent sense.

19. BUTO, the nurse of Horus and of Bubastis, compared to the Latona of the Greeks, must be considered as anterior to the birth of Horus.

20. HORUS, *Hor*, *Or*, or *Horsiesi*, was the son of Isis and Osiris. Jablonsky observes, that a king *Ur* is mentioned by Manetho, and that *Or* was, in later times, the name of a certain monk, and *Taor* of a nun: the Egyptians having always, as Lucian informs us, had a propensity to adopt the names of their deities for their own, so that they may have become current in families without any immediate reference to their origin. Akerblad has also found *Horsiesi* as an Egyptian name, and conjectures, not without probability, that it may have meant originally Horus, the son of Isis; SI being an abridgment of SHERI, as it appears also to have been in the name *Siphoas*, or rather *Siphthas*, which is explained by Eratosthenes, *the son of Vulcan*. Horus is often confounded with the Sun, perhaps from the resemblance of his name to the Hebrew AOR, *light*; while Suidas makes him rather analogous to Priapus. He was nursed by Buto, in the city Butus. The most remarkable exploit of his youthful days was the pursuit and conquest of Typhon, in revenge for his father's death. The constellation Orion was supposed to be the habitation of his soul. His dress was white. Damascius, as copied by Photius, informs us that he was represented with his finger on his mouth.

21. HARPOCRATES was a son of Osiris, from a visit paid to Isis after his death. He was also born prematurely, and was weak in his lower limbs. Eratosthenes seems to have called him Phrucrates; and PHROKHRAT, in Coptic, would mean dried or *withered feet*.

22. ANUBIS was the offspring of Osiris and Nephthe, whom he had mistaken for Isis, and who exposed the child; but Isis recovered him, and he became her faithful attendant. He was considered as belonging both to the upper and the lower worlds, and was therefore compared to the horizon: and he seems to have been typified by a dog, or figured with a dog's head. He attended Osiris in his military expedition; and he is sometimes erroneously confounded with Mercury, and even with Saturn. A cock was usually sacrificed to him; and Pliny tells us, that his images were properly made of gold, in allusion to his name; a remark which is amply explained by the Coptic word NUB, which still signifies *gold*. Pantheon.

23. ARSAPHES is mentioned by Plutarch as a son of Isis; but the same name is said to have been sometimes applied to Osiris.

24. ATHOR, or *Athyr*, was the Venus of the Egyptians, according to the Great Etymologicon. Herodotus mentions a temple of Venus at Atarbechis, which might be translated the city of Venus, BAKI in Coptic meaning city; although Plutarch enumerates Athyri among the different names of Isis. Strabo informs us, that at Momemphis, a sacred cow was fed in honour of Venus.

25. AMUN, the Jupiter of the Egyptians, though apparently a personage of much less importance than the Greek and Roman Jupiter, was worshipped by the Ammonians, under the form of a human figure, with a ram's head. Hecataeus, as quoted by Plutarch, denies that this term is the proper name of the deity, and observes, very truly, that it is an Egyptian word meaning *come*, by which the god was supplicated to appear. The word, however, implies also *glory*, or *splendor*. If there was a more appropriate term for this deity, it may possibly, as Mr Akerblad has observed, have been *Ho*, which was the Egyptian name of the city, called by the Greeks Diospolis the Less. It is remarkable, that Manetho gives us a Zeus distinct from Ammon, interposing Tithoes and Sosus as intermediate kings.

26. ANTAEUS, *Entes*, or *Mendes*, is said to have been left by Osiris as a viceroy or lieutenant governor, together with Busiris, for the assistance of Isis, during his absence. He is generally identified with Pan, though Diodorus mentions Pan as having accompanied Osiris on his expedition. At Mendes a goat was fed in honour of this deity, and Plutarch seems to say, that this goat was called Apis, as well as the bull fed at Memphis. He was also generally represented with the face and legs of a goat. Herodotus calls him one of the eight gods, older than the twelve; but Diodorus makes the eight senior gods of the Egyptians the Sun, Cronus, Rhea, Ammon, Juno, Vulcan, Vesta, and Mercury. Out of these, however, Juno and Vesta cannot easily be identified in the Egyptian mythology.

27. BUSIRIS is only mentioned by Diodorus as a colleague of Antæus in his government.

28. MACEDON, according to Diodorus, was a companion of Osiris in his expedition.

29. BUBASTIS was a sister of Horus, preserved and nursed with him by Buto in the city of Butus. She is compared, by various authors, to Artemis or Diana: Apuleius gives us Bubasthis for the Egyptian name of the plant Artemisia; and Bubastis is addressed in a Greek epigram in the place of Diana, considered in her obstetrical capacity.

30. SARAPIS, an ancient deity of the Greeks, was raised into a more distinguished rank by the honours paid him, as identical with Pluto, by Ptolemy Soter, who had found an image of Pluto at Sinope, accompanied by Cerberus and a dragon, which he brought to Alexandria, and established in the Serapeum there, as belonging to Sarapis. Some of the ancients were, however, of opinion, that the word Sa-

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rapis meant only the *feast of Apis;* and, indeed, the Coptic SHAIIRI, which signifies to feast, agrees tolerably well with this etymology, however improbable the opinion founded on it may be esteemed. Sarapis is also supposed to have had some relation to the regulation of the Nilometer, which consisted of a column with different heights marked on it, in the centre of a bath or well, into which the water of the river was admitted.

31. ESMUNUS, or *Shmun,* was the eighth son of Sadycus by one of the Titanides, and brother of the Dioscuri and Cabiri; all of them names which seem as foreign to the Egyptian mythology, as the word SHMŪN is familiar to the language, meaning simply *eight.* He is, however, said by Damascius to have been the Egyptian Æsculapius, although Manetho gives the name Tosorthrus to this deity, making him a son of Pan and Hephæstobule.

32. PAAMYLES is mentioned by Hesychius and Plutarch as a Priapic deity; he is also made by Cratinus synonymous with *Socharis.*

33. TITHRAMBO, according to Epiphanius, was analogous to the Hecate of the Greeks.

34. THERMUTHIS, though generally understood to be only a name of the sacred serpents worn in the crown of Isis, is distinguished by Epiphanius as an independent deity; and if we may judge by the signification of the Coptic word, which means *mortiferous,* her character must have been somewhat analogous to that of Nemesis.

35. CANOPUS, or *Canobus,* had a temple which is mentioned by Dionysius Periegetes. The jars called Canopi were often made porous, to serve as filters, and are mentioned by Hesychius, in the word *Stactice;* but we are not exactly informed how far they were connected with this deity.

36. MENUTHIS was the wife of Canopus, and seems to have given her name to a village near the town Canopus, which is mentioned by Stephanus. Epiphanius calls her *Eumenuthis.*

37. BESA is only known from Ammianus Marcellinus, who mentions an oracle dependent on him.

38. PROTEUS, though noticed as a king of no very high antiquity, is said to have had a temple erected to him as a hero. Diodorus says that his Egyptian name was Cetes; though Herodotus, as in other instances, fancies, from some misapprehension, that the Greek and Egyptian names were identical; and he observes, that similar honours were also paid to Perseus, another hero known to the Greeks.

39. NILUS, whether as a king or merely as a river, appears to have received divine honours. The Egyptian name of the Nile seems to have been simply PHIARO; the Ethiopians called it *Siris;* the AMEÏRI of Kircher's vocabulary was probably a name of later date.

40. APIS, a bull consecrated to Osiris, was fed, with divine honours, at Memphis, the principal burying place of that deity, of whose soul he was considered as the living image. He was all over black, except some small white spots, and some other particular marks not of common occurrence. He was sometimes said to be the offspring of a cow and a ray of moonlight.

41. MNEUIS, or *Mnyis,* was also a black bull, sacred to Osiris, kept at Heliopolis; although some authors assert that he was sacred to the sun. Ælian mentions also a black bull called Onuphis; and Macrobius speaks of a bull named Pacis, or Bacis, and kept at Hermonthis. For the cow that was consecrated to Venus, it does not appear that any particular name has been recorded.

Historiography.

SECTION III.—*Historiography of Egypt.*

The early history of Egypt claims a much higher antiquity than that of almost any other nation; and is consequently involved in darkness more impenetrable. It is utterly impossible to reconcile the accounts of various authors with each other; and even the same authors are not always consistent with themselves. But some little idea may be formed of the comparative value of the different catalogues of sovereigns, by observing which of them is confirmed by the testimony of the greatest number of respectable and unconnected writers, and by inquiring, at the same time, what internal evidence they afford of truth or falsehood.

The only original authorities on which we can depend, for the early history of Egypt, are those of Herodotus, Manetho, Eratosthenes, Diodorus Siculus, and Strabo; all of whom had been more or less in the country. Herodotus lived soon after the conquest of Egypt by Cambyses, when the names of the later monarchs could not easily have been forgotten. The earlier part of his history is of a much more apocryphal nature: he does not, however, continue the series of the kings further back than Sesostris and Moeris: so that almost all his names are sufficiently recent to be considered as completely within the province of legitimate history. Manetho lived under Ptolemy Philadelphus, to whom he dedicated his three books of the *History of Egypt;* and there is little doubt that the extracts, preserved by Josephus, Eusebius, and Syncellus, although some of them have passed in succession from one compiler to another, are in general perfectly authentic. How much of the work was originally fabulous, and how much has been distorted by transposition and anachronism, it is impossible accurately to determine: but besides the original inadmissibility of the existence of so long a series of successive generations, the invention of which may possibly have been derived from the same national vanity, that led the priests to boast to Herodotus of 330 kings between Menes and Sesostris, there are several coincidences, which Marsham has pointed out, in the names and qualifications of princes mentioned as having lived at very remote times, tending strongly to encourage the opinion, that the originals of the stories were respectively one and the same person; there are also other instances, in which it is not improbable, that several of the persons enumerated may have been contemporary sovereigns of different subdivisions of the country, although this part of Marsham's theory has perhaps been carried a little too far: and amidst so much confusion, it must be confessed that all his learning and all his ingenuity have been inadequate to the establishment of any

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satisfactory result. He holds the catalogue of Eratosthenes in high and just estimation, although he was not acquainted with the strong argument in favour of its authenticity, which has been deduced from the agreement of many of the etymologies with the acknowledged meaning of the terms in the Egyptian language; an agreement which makes it more than probable that Eratosthenes, who lived in the reign of Ptolemy Euergetes, did actually receive these names and their interpretations from the priests of Diospolis. This interesting catalogue has been successively copied by Apollodorus, Africanus, Eusebius, and Syncellus; but how many of the names contained in it were really those of actual sovereigns of Egypt, and how many had been negligently or ignorantly read and pronounced, it is by no means easy to ascertain: it can only be observed in general, that scarcely any of them are found in the works of other chronologers or historians. Diodorus is, on the whole, a very candid and judicious writer, and we shall hereafter find some remarkable evidence of his correct knowledge of the Egyptian institutions; although some of the most approved critics of modern times have entertained considerable prejudices against him. The accuracy and good sense of Strabo are so well known, that we can only lament the paucity of the historical facts that can be collected from him. Besides these authors, there is an anonymous chronicle copied by Africanus, and from him by Syncellus, which affords a series of kings somewhat shorter than that of Manetho, and more regularly filled; it seems, however, to be principally a compilation from Manetho, with some regard to the contemporary events of the scriptural chronology.

That MENES, whom many suppose to have been Misraim, the son of Ham, was the first king of Egypt, is fully agreed by all authors; and both Manetho and Eratosthenes make his immediate successor ATHOTHES; and, together with Herodotus, mention NITOCRIS as one of the early queens. Besides these coincidences, there are slight resemblances in the names of six or seven of the intermediate personages of the respective lists; but it is impossible to pronounce with confidence, that the circumstance is any thing more than accidental: and, in fact, we find little or no collateral confirmation of the accuracy of any others of the appellations, till we come down to the 18th dynasty of Manetho; the Phenician shepherds, who are referred to the 17th, being little mentioned by other historians, and very few, even of their supposed names, having been preserved by Manetho. But we find a particular catalogue of the 18th dynasty both in Josephus and in Eusebius, bringing us down to the time of Sesostris, with whom the histories of Herodotus and Diodorus may be said to begin. So far, therefore, as the chronology of the kings of Egypt can be recovered from these documents, it will stand nearly as in the subjoined table; the dates being deduced from the lengths of the several reigns as given by Manetho alone, taking the means of the different readings of the numbers, aud setting out with the presumption, that the conquest of Psammenitus by Cambyses happened 525 years B. C.

6

According to Manetho.

	Years	B. C.
XVIII Dynasty. Diospolitan.		
1. Thuthmosis, or Amosis, reigned	24 years	1874
2. Chebron, his son -	13	1750
3. Amenophthis -	20	1737
4. Ammessis, sister -	18	1717
5. Mesphres, son -	16	1699
6. Misphragmuthosis -	23	1683
7. Thmosis, or Thuthmosis, s.	9	1660
8. Amenophis, s. (" Memnon.")	31	1651
9. Horus, s. -	41	1620
10. Acenchres, d. -	23	1579
11. Rathotis, sist. -	15	1556
12. Acencheres, s. -	17	1541
13. Acencheres, ii. s. -	11	1524
14. Armaïs -	6	1513
15. Ramesses, s. - / 16. Armesses Miamun, s.	68	1507
17. Amenophis, or Ammenoph	15	1439
XIX Dynasty. Diospolitan.		
18. Sethosis, or Sesostris	53	1424
19 Rapsaces -	63	1371
20. Ammenephthes / 21. Rameses	60	1308
22. Ammenemes -	15	1248
23. Thuoris -	7	1233
XX Dynasty Diospolitan.		
24. . 35. Twelve kings	125	1226
XXI Dynasty. Tanite.		
36. Smendes -	26	1101
37. Psusennes -	41	1075
38. Nephelcheres -	4	1034
39. Amenophthis -	9	1030
40. Osochon -	6	1021
41. Psinaches -	9	1015
42. Psusennes -	35	1006
XXII Dynasty. Bubastite.		
43. Sesonchosis -	21	971
44. Osorchon -	15	950
45. . . . . / 46. . . . . / 47. . . . . -	25	935
48. Tacellothis -	13	910
49. . . . . / 50. . . . . / 51. . . . . -	42	897
XXIII Dynasty. Tanite.		
52. Petubastes (I. Olymp.) -	30	855
53. Osorchon - -	9	825
54. Psammus - -	10	816
55. Zet... - -	31	806
XXIV Dynasty. Saïte.		
56. Bocchóris - -	44	775
XXV Dynasty. Ethiopian.		
57. Sabacon - -	10	731
58. Sevechus - -	13	721
59. Tarachus - -	19	708

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XXVI. Dynasty. Saïte.

			B.C.
60.	Ammeres	12 years	689
61.	Stephinates	7	677
62.	Nechepsus	6	670
63.	Nechao	8	664
64.	Psammitichus	48	656
65.	Nechao ii.	6	608
66.	Psammuthis	12	602
67.	Vaphres	22	590
68.	Amosis	43	568
69.	Psammecheritus	0	525

According to Herodotus.

1. Sesostris, M. 18.
2. Pheros, s.
3. Proteus.
4. Rhampsinitus.
5. Cheops (Pyr.)
6. Chephren (Pyr.)
7. Mycerinus (Pyr.)
8. Asychis, M. 40 ?
9. Anysis, M. 41 ?
10. Sabacus, M. 57.
11. Sethon, M. 58.
12. Dodecarchia.
13. Psammitichus, M. 64.
14. Necos, s. M. 65.
15. Psammis, M. 66.
16. Apries, M. 67.
17. Amasis, M. 68.
18. Psammenitus, M. 69.

According to Diodorus.

(After Osymandyas, and many more.)
1. Sesoosis, M. 18.
2. Sesoosis, ii. s. (Nuncoreus another son.)
3. ...Many others.
17 ? Ammosis.
18. Actisanes.
19. Mendes or Marus (Lab.) M. 36 ?
Interregnum of five generations.
20. Cetes or Proteus, H. 3.
21. Remphis, H. 4.
22..28, Nilus and others.
29. Chemmis, H. 5.
30. Cephres, H. 6.
31. Mycerinus, H. 7.
32. Bocchoris, M. 56.
33. Sabbacon, M. 57.
34. Dodecarchia, H. 12.
35. Psammetichus, M. 64.
36..39, Four generations.
40. Apries, M. 67.
41. Amasis, M. 68.

It is only in the name and order of the nine last sovereigns, that the three catalogues agree so well as to be considered as fully confirming each other: Before these, the Asychis and Anysis of Herodotus are not unlike the Osochon and Psinaches or Sinaches, which stand together at a much earlier period, in the longer list of Manetho. The Cheops, or Chemmis, Chephren, and Mycerinus of the two Greek historians, supposed to be the builders of the pyramids, are no where found in Manetho, who attributes some of these extraordinary edifices to the fourth dynasty, in which we have Suphis, Suphis, and Mencheres, each supposed to have reigned more than sixty years, the names having so much of general resemblance to those of Herodotus, that they may easily have been corruptions of the same originals. It is impossible to conjecture what date we ought to assign to this dynasty, although it is remarkable that the names and characters of several of the kings agree sufficiently well with those of Sesostris and his immediate predecessors, which occur much later in the catalogue. But, considering that not a single hieroglyphical representation has yet been discovered about the pyramids, there is no reason to induce us to bring down their date so low as to this period, much less to believe, with Herodotus, that they were built only twelve generations before the time of Cambyses. The third pyramid, in Africanus's extract from Manetho, is attributed to Nitocris, who is referred to the sixth dynasty. The different passages of Manetho, which Syncellus has copied from Africanus and from Eusebius, exhibit many other variations, both in names and dates, which would require the catalogue to be considerably extended, if we admitted into it all the personages enumerated; while, on the other hand, a comparison with other authorities makes it more desirable that we should abridge the whole period by about 300 years out of the 1350 which it occupies, in order that Thuthmosis or Amosis might become contemporary with Moses, as Josephus makes him. But it is obvious that this degree of anachronism is not enough to vitiate the general truth of Manetho's statement of the names and order of succession of the sixty or seventy sovereigns preceding Cambyses; at the same time we must admit the accuracy of the respective dates with considerable latitude, and the more as their antiquity becomes greater. Thus the taking of Troy is mentioned as having happened in the time of Thuoris, the commencement of whose reign our catalogue makes 1233 B. C., that is, only 50 years earlier than the date assigned to this event from other authorities; and Petubastes, who is said to have been reigning at the institution of the Olympiads, stands full 50 years too far back for the commencement of the Olympic era, though he is somewhat more modern than the date at which Iphitus is said to have instituted the games. It would, however, be unreasonable to expect, considering the imperfect nature of the evidence that we possess, a coincidence much more accurate.

Calendar.

Section IV.—*Of the Egyptian Calendar.*

From the chronology of Egypt, we may pass very naturally to the consideration of its calendar, which has often been a subject of speculation both with critics and with astronomers. The inquiry is in itself somewhat intricate; but the principal difficulties have arisen from the ignorance or carelessness of the Greek authors, who have written on the Egyptian mythology. The Baron Alexander von Humboldt and Mr Jomard have displayed great learning and research in collecting authorities on this subject; and nothing is wanting, to establish the propriety of their acquiescence in the opinion of Petavius, except a little less indulgence for the extreme inattention of Plutarch, and a more marked deference to the important testimony of Erastosthenes, a writer whose catalogue of the Egyptian kings has already been noticed, as bearing intrinsic marks of the authenticity of his information, and whose competency, as an accomplished astronomer, to discuss the regulation of the calendar, is of still greater notoriety. Geminus, a Greek astronomer of the Augustan age, has very distinctly stated, that the later Greeks had been in the habit of mentioning the Egyptian festivals as connected with particular seasons of the year, in spite of the clearest evidence that their my-

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thological year consisted of 365 days only, and that their anniversary festivals must necessarily have passed in succession through every part of the natural year. "It is a common and inveterate error among the Greeks," says Geminus, "to believe that the festival of Isis happens at the winter solstice. This was indeed true 120 years ago; but it is now a month earlier; and such a mistake betrays the grossest ignorance of the Egyptian calendar. In former ages, this festival was celebrated not only as late as the winter solstice, but, at an earlier period of time, even at the summer solstice; as Eratosthenes expressly states, in his *Commentary upon the Octaeterides*." (*Geminus in Petav. Uranologia*. Par. 1630, f. p. 33.)

The later inhabitants of lower Egypt, and especially the Greeks of Alexandria, had certainly a stationary as well as a wandering year; but this was no other than the Julian year, which was introduced here some little time after its establishment in other parts of the Roman empire; and which was probably the only year ever employed by the Coptic Christians, although it can scarcely have been adopted at any time by the Pagan Egyptians. The common opinion is, that the Julian calendar was established at Alexandria, in the year 25 B. C., the first month Thoth then beginning on the 29th of August, as the Coptic year continued to do ever after. Thus Vansleb found, in the seventeenth century, that Thoth began on the 8th of September N. S., which was the 29th of August O. S. A passage of Theon, in his *Commentary on Ptolemy*, would rather incline us to fix on the 1st September for the beginning of the Alexandrian year; but the ecclesiastical authority is more direct, and it is confirmed by the present usage of the Abyssinian church. The quadriennial intercalation of a sixth supplementary day took place, according to the Abbé Boyer, at the end of the second year after the Julian bissextile; so that, in the year preceding the bissextile, the first of Thoth happened on the 30th of August. From these authorities, we have no difficulty in ascertaining the beginning of the ancient or moveable Egyptian year for any earlier or later period; reckoning both ways, for the sake of simplicity, in Julian years.

B. C. 1500	2d Sept. O. S.	B. C. 400	1st Dec.
1400	8th Aug.	300	6th Nov.
1300	14th July.	200	12th Oct.
1200	19th June.	100	17th Sept.
1100	25th May.	B. of C.	23d Aug.
1000	30th April.	100	29th July.
900	5th April.	200	4th July.
800	11th March.	300	9th June.
700	16th Feb.	400	15th May.
600	21st Jan.	500	20th April.
500	26th Dec.		

It is of importance, in the discussion of some representations of astronomical objects, to determine at what time of the year the sun entered the respective signs, according to the Egyptian calendar, or, more particularly, what was the sun's place in the starry zodiac at the commencement of the year, for different periods of time. Taking, then, 6 h. 9′ 8″ for the excess of the sidereal above the Egyptian year, we find that 1424 Julian years were required for a complete revolution of the sun's place on the 1 Thoth, and 119 for each sign. Now since, about a century before the establishment of the Julian calendar, the sun entered Libra on the 24th of September; and since the Egyptian year began on that day, in 120 B. C., it follows that Libra had been the first constellation during the whole of the preceding century; for, at this period, the beginning and end of the signs of the ecliptic agreed very nearly with those of the corresponding constellations of the zodiac. The first constellation of the Egyptian year will therefore stand nearly thus:

From 1552 B. C.	484 ♑
to 1433 ♍	365 ♐
1314 ♌	247 ♏
1196 ♋	128 ♎
1077 ♊	9 ♍
958 ♉	A. C. 110 ♌
840 ♈	228 ♋
722 ♓	347 ♊
603 ♒	

We may take, for an example of an Egyptian date, that of the Rosetta stone, in the ninth year of Ptolemy Epiphanes, or 196 B. C., when the Egyptian year must have begun on the 11th of October; consequently, the first of the sixth month, Mechir, was the 9th of March, and the 18th of Mechir, which is made synonymous with the 4th of Xanthicus, the 26th of March: so that Xanthicus must constantly have begun on the 22d of March, if the intercalations were properly adjusted; and this agrees sufficiently well with Usher's table of the Macedonian "lunar" months, which may therefore be supposed to have been generally employed by the Greeks in Egypt.

If we attempt to determine the date of a given monument from astronomical symbols contained in it, we must suppose that they represented the state of the heavens with respect to the Egyptian year at the time in question. Thus, in the zodiacs of the ruins at and near Esne or Latopolis, the constellation Pisces seems to be the first sign, as it really was, about 800 B. C. or in the time of Bocchoris and of the Ethiopian dynasty. It is, however, equally possible, that Virgo may have been intended for the first sign, and this would answer either to the century immediately preceding the birth of Christ, or to a period fourteen centuries earlier. The zodiac at Dendera appears to begin with Leo; and unless we suppose its antiquity extravagantly great, we must refer it to the time of Tiberius, as Visconti has indeed already remarked. Mr Hamilton has confirmed this opinion by the collateral evidence of inscriptions in honour of the Roman emperors: although, with respect to the difference of time implied by the difference of a sign in the beginning of the zodiacs, he is rather inclined to adopt the sentiments of Lalande, who refers it to the effect of the precession of the equinoxes; imagining, without any kind of authority, that the division of the signs corresponded to the period of the solstices, a period which never constituted a marked feature in the Egyptian calendar.

Calendar.

In the zodiac at Esne, the sign Libra is denoted, as is usual in the Roman representations, by a female holding the balance; while the Egyptian constellation, in most other instances, is without the female. Servius, however, informs us, that the Romans borrowed this sign from the Egyptians, the Greek astronomers having considered it as a part of the Scorpion; so that there is no reason to question the antiquity of the ceiling, from the occurrence of this constellation in it. The sign Cancer, both here and elsewhere, has eight feet, and it has certainly no connexion with the figure of the sacred beetle, which occurs many thousands of times in other places, but never with more than six feet.

The beetles in the zodiac of Dendera have a very different signification, and the whole representation is much more of a mythological than of an astronomical nature. The beetle near the beginning of the zodiac is the well known symbol of generation, and he is in the act of depositing his globe: on the opposite side, at the end of the zodiac, is the head of Isis, with her name, as newly born; both the long female figures are appropriate representations of the mother; and the zodiac between them expresses the "revolving year" which elapsed between the two periods. This explanation is completely confirmed by a similar representation of two female figures on the ceiling of the first tomb of the kings at Byban El Molouk; one with the beetle, the other with the name of the personage just born: between them, instead of the zodiac, are two tablets, divided into 270 squares, or rectangles, corresponding to the number of days in nine Egyptian months, with ten circles placed at equal distances, probably intended to represent full moons, and relating to the ten incomplete lunations to which these days must belong. The number 270 is too remarkable to be supposed to have been introduced by mere accident; and when the argument is considered as a confirmation of other evidence, in itself sufficiently convincing, the whole must be allowed to be fully conclusive.

There is indeed little chance of our discovering any astronomical records of importance among the profusion of hieroglyphical literature which is still in existence. Herodotus tells us, that the Greeks derived their acquaintance with astronomy from the Babylonians, though they were supposed to have learned the elements of geometry from the Egyptians: and it is well known that Ptolemy the astronomer, who lived at Alexandria, and who must have had easy access, as well as Eratosthenes before him, to all the knowledge of the Egyptian priests, refers to no Egyptian observations, but employs the Babylonian records of eclipses which had happened a few centuries before his time; records, which, as Pliny informs us, were preserved on a particular kind of bricks, the same, perhaps, that have been brought to Europe in our own times, as undeciphered specimens of the nail, or arrow headed character. But a certain degree of geometrical knowledge can scarcely be denied to a people, who had made very considerable progress in sculpture and architecture, at a time when all Europe was immersed in the profoundest barbarism, and who must necessarily have had frequent occasion for the employment of agrarian measurements. The Egyptians must also have been good practical chemists; so far, at least, as was required for the preparation of brilliant and diversified and durable pigments: and even their devotion to alchemy, which derives its name from having been the *secret* or *dark* study of Egypt, must have led them to make some little progress in experimental philosophy, although neither their manufacturers nor their magicians could have any right to boast of solid acquirements in genuine science.

The months of the fixed or Alexandrian year were these:

1.	Thoth,	began 29th August, O. S.
2.	Paopi,	28th September.
3.	Athor,	28th October.
4.	Choeak,	27th November.
5.	Tobi,	27th December.
6.	Mechir,	26th January.
7.	Phamenoth,	25th February.
8.	Pharmuthi,	27th March.
9.	Pashons,	26th April.
10.	Paoni,	26th May.
11.	Epep,	25th June.
12.	Mesore,	25th July.

The years are commonly dated from the era of the martyrs of Diocletian, beginning in the autumn of 284.

Customs and Ceremonies.

SECTION V.—*Egyptian Customs and Ceremonies.*

Herodotus, Diodorus Siculus, and Plutarch, have entered at large into an account of the manners and opinions of the ancient Egyptians; but it is difficult to ascertain in what precise proportion we ought to consider their information as accurate. A few insulated observations are, however, sufficiently striking to attract our attention; and there are some passages of Strabo, whose veracity, with respect to what he had seen, is undoubted, that will serve to afford us an introductory view of some of their usages. He gives us, for example, an interesting description of the usual form of the Egyptian temples, and of the habits of the sacred animals, which were frequently kept in them. "At the entrance of the sacred inclosure," he says (Book 17), "there is a paved area, about a hundred feet wide, or a little less, and three or four times as long, or sometimes even more: this area is called the dromus, or course, as in the line of Callimachus, 'This sacred course the great Anubis claims.' On each side of the whole length of this area is a row of sphinxes of stone, at the distance of 30 feet, or a little more, from each other; one row on the right hand, and the other on the left. Beyond these is the first great propylon; then, as you advance, a second and a third; their number not being limited, any more than that of the sphinxes, but both varying in various temples, as well as the length and breadth of the dromus. Next to the propyla is the temple, properly so called, consisting of a large and splendid pronaos, and a moderate cella or secos, without any image, at least in a human form, but commonly with the representation of some animal. On each side of the pronaos

Customs and Ceremonies.

there is a projecting wing; that is, a wall of equal height with the temple; at the beginning of the wings, their distance from each other is a little more than the breadth of the extreme border of the temple, but as we advance forwards, they incline till it becomes about 80 or 90 feet. The walls are sculptured with the representations of large figures, in the style of the Etruscan, or the very ancient Greek decorations. Some of their buildings are encumbered with a multitude of columns, as at Memphis, in a barbarous style of architecture; for, besides that the columns are heavy, and numerous, and in a variety of rows, they have nothing graceful nor picturesque about them, but merely exhibit ill directed labour, without good taste.

"At Heliopolis we saw some large buildings appropriated to the accommodation of the priests; and it is said that this colony or college was formerly remarkable for the residence of philosophers and astronomers; but their habits and studies are no longer of so refined a nature. It was here that Plato and Eudoxus passed a considerable time; and, as some say, not less than thirteen years; for the priests were very cautious of imparting their knowledge; and though courted patiently by all sorts of attentions, would at last only communicate to them a small part of the theorems which they had discovered. They taught them, however, the true length of the year, as exceeding 365 days; but the Greeks were not accurately acquainted with its magnitude, until they had obtained translations of the sacred commentaries of the Egyptians.

"At Memphis, the capital of Egypt, there are several temples, among which is that of Apis, or Osiris, where the bull Apis is fed, in a sacred stable, being honoured as a deity: he has white spots on his forehead, and on some other small parts of his body, but with this exception he is completely black. In front of the stable is a court, with another stable appropriated to his mother: into this court the bull is turned at certain hours, especially when he is to be exhibited to strangers, who, however, are allowed to see him at other times through a window of his stable: when he has leaped about and taken his exercise, he is soon shut up again. In the dromus of the temple of Vulcan it is usual to exhibit combats of bulls, the animals being fed for this express purpose. There is also a temple of Aphrodite or Venus, and another of Serapis in a very sandy place, where we saw some of the sphinxes already buried up to the necks by the effect of the winds."—"In the city of Arsinoe, which was formerly called Crocodilopolis, the crocodile is worshipped, and a sacred crocodile is kept in a pond, who is perfectly tame, and familiar with the priests. He is called Suchus; they feed him with corn, and meat, and wine, which are continually brought him by strangers. The friend who conducted us had provided a cake, and some meat, and a vessel of water and honey: we found him on the bank of his pond; the priests held open his mouth, while one of their number put the cake and the meat into it, and then poured the liquor on them; the animal then jumped into the pond, and crossed to the opposite side, where he was again fed in a similar manner, with the offerings of another visitor." It appears, therefore, that in the days of Augustus these sacred animals were not regarded with much more awe than the inmates of a menagerie in modern times.

Customs and Ceremonies.

The stories of Herodotus, though told with an elegant simplicity, and with every appearance of good faith, are by no means free from a frequent mixture of fable; and, with respect to his Egyptian etymologies, he is almost univerally mistaken; but his account of the ceremonies observed in the preparation of the mummies has many marks of authenticity, and he is perfectly correct in asserting that the most splendid of the coffins are formed in imitation of the figures of Osiris; a circumstance which he could not easily have conjectured without direct and accurate information.

There is, however, a still stronger confirmation of the veracity of Diodorus Siculus, from the coincidence of a number which he mentions, with a variety of Egyptian monuments still existing. He tells us that a talent of silver was sometimes expended on the funeral of an individual. "The relations of the deceased announce," he says, "to the judges, and to all the connexions of the family, the time appointed for the ceremony, which includes the passage of the deceased over the lake or canal of the nome to which he belonged. *Two and forty* judges are then collected, and arranged in a semicircle, which is situated beyond the canal; the boat is prepared, and the pilot is called by the Egyptians Charon; whence it is said that Orpheus borrowed the mythological character of this personage. Before the coffin is put into the boat, the law permits any one that chooses to produce his accusations; and if it is proved that the life of the deceased was criminal, the funeral is prohibited, while all false accusations are severely punished. If there are no accusations, or when they have been repelled, the relations of the deceased lay aside their lamentations, and pronounce his encomiums; asserting that he is about to pass a happy eternity with the pious, in the regions of Hades; and the body is finally deposited in the catacomb prepared for it." The history of so extraordinary a ceremony certainly required some confirmation to make it appear consistent with probability; but the number of forty two judges is found in a great variety of pictural representations, and in some inscriptions, so that the account must have been given by a person well acquainted with the practice of the country; and, when thus established, it demonstrates also the truth of the received opinion, that the Egyptians believed in a future state of rewards and punishments. (*Phil. Trans.* 1819.)

In cases of civil law suits, the number of judges, according to the same author, was only thirty; their president wearing a breast plate adorned with jewels, which was called Truth. The eight books of the laws were placed near the judges: the pleadings of the advocates were all conducted in writing only, in order that the feelings of the judges might not be improperly biassed by the too energetic eloquence of an impassioned orator; and the president delivered the sentence of his colleagues, by the form of touching the successful party with the symbol of justice which he wore.

Triple Inscription of Rosetta.

SECTION VI.—*Analysis of the triple inscription of Rosetta.*

Having acquired some preliminary notions of the mythology and history, and chronology and institutions, of ancient Egypt, we may proceed to the discussion of its written language and literature, as far as they are likely to be recovered from existing monuments; and, first of all, we must inquire into the best mode of obtaining some satisfactory conclusions from the invaluable inscriptions in honour of Ptolemy Epiphanes; which contain the only authentic specimen in existence of hieroglyphical characters expressly accompanied by a translation.

The block or pillar of black basalt, found by the French in digging up some ground at Rosetta, and now placed in the British Museum, exhibits the remains of three distinct inscriptions: and the last, which is in Greek, ends with the information, that the decree, which it contains, was ordered to be engraved in three different characters, the sacred letters, the letters of the country, and the Greek. Unfortunately a considerable part of the first inscription is wanting: the beginning of the second, and the end of the third, are also mutilated; so that we have no precise points of coincidence from which we can set out, in our attempts to decipher the unknown characters. The second inscription, which it will be safest to distinguish by the Greek name *enchorial,* signifying merely the characters "of the country," notwithstanding its deficiencies near the beginning, is still sufficiently perfect to allow us to compare its different parts with each other, and with the Greek, by the same method that we should employ if it were entire. Thus, if we examine the parts corresponding, in their relative situation, to two passages of the Greek inscription in which *Alexander* and *Alexandria* occur, we soon recognise two well marked groups of characters resembling each other, which we may therefore consider as representing these names; a remark which was first made by Mr de Sacy, in his Letter relating to this inscription. A small group of characters, occurring very often in almost every line, might be either some termination, or some very common particle: it must, therefore, be reserved till it is found in some decisive situation, after some other words have been identified, and it will then easily be shown to mean *and.* The next remarkable collection of characters is repeated twenty nine or thirty times in the enchorial inscription; and we find nothing that occurs so often in the Greek, except the word *king,* with its compounds, which is found about thirty seven times. A fourth assemblage of characters is found fourteen times in the enchorial inscription, agreeing sufficiently well in frequency with the name of *Ptolemy,* which occurs eleven times in the Greek, and generally in passages corresponding to those of the enchorial text in their relative situation: and, by a similar comparison, the name of Egypt is identified, although it occurs much more frequently in the enchorial inscription than in the Greek, which often substitutes for it country only, or omits it entirely. Having thus obtained a sufficient number of common points of subdivision, we may next proceed to write the Greek text over the enchorial, in such a manner that the passages ascertained may all coincide as nearly as possible; and it is obvious that the intermediate parts of each inscription will then stand very near to the corresponding passages of the other.

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In this process, it will be necessary to observe that the lines of the enchorial inscription are written from right to left, as, Herodotus tells us, was the custom of the Egyptians; the division of several words and phrases plainly indicating the direction in which they are to be read. It is well known that the distinct hieroglyphical inscriptions, engraved on different monuments, differ in the direction of the corresponding characters: they always face the right or the left of the spectator according as the principal personages of the tablets, to which they belong, are looking in the one or the other direction; where, however, there are no tablets, they almost always look towards the right; and it is easily demonstrable that they must always have been read beginning from the front, and proceeding to the rear of each rank. But the Egyptians seem never to have written alternately backwards and forwards, as the most ancient Greeks occasionally did. In both cases, however, the whole of the characters thus employed were completely reversed in the two different modes of using them, as if they were seen in a glass, or printed off like the impression of a seal.

By pursuing the comparison of the inscriptions, thus arranged, we ultimately discover the signification of the greater part of the individual enchorial words; and the result of the investigation leads us to observe some slight differences in the form and order of some parts of the different inscriptions, which are indicated in the "conjectural translation," published in the *Archaeologia* and in the *Museum Criticum.* The degree of evidence in favour of the supposed signification of each assemblage of characters may be most conveniently appreciated, by arranging them in a lexicographical form, according to the words of the translation; the enchorial words themselves not readily admitting a similar arrangement: but the subject is not of sufficient interest for the public, to make it necessary that this little lexicon should be engraved at length.

It might naturally have been expected that the final characters of the enchorial inscription, of which the sense is thus determined with tolerable certainty, although the corresponding part of the Greek is wanting, would have immediately led us to a knowledge of the concluding phrase of the distinct hieroglyphical characters, which remains unimpaired. But the agreement between the two conclusions is by no means precise; and the difficulty can only be removed by supposing the king to be expressly named in the one, while he is only designated by his titles in the other. With this slight variation, and with the knowledge of the singular accident, that the name of Ptolemy occurs three times in a passage of the enchorial inscription, where the Greek has it but twice, we proceed to identify this name among the sacred characters, in a form sufficiently conspicuous, to have been recognised upon the most superficial

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examination of the inscriptions, if this total disagreement of the frequency of occurrence had not imposed the condition of a long and laborious investigation, as an indispensable requisite for the solution of so much of the enigma: this step, however, being made good, we obtain from it a tolerably correct scale for the comparative extent of the sacred characters, of which it now appears that almost half of the lines are entirely wanting, those which remain being also much mutilated. Such a scale may also be obtained, in a different manner, by marking, on a straight ruler, the places in which the most characteristic words, such as *god*, *king*, *priest*, and *shrine* occur, in the latter parts of the other inscriptions, at distances proportional to the actual distances from the end; and then trying to find corresponding characters among the hieroglyphics of the first inscription, by varying the obliquity of the ruler, so as to correspond to all possible lengths which that inscription can be supposed to have occupied, allowing always a certain latitude for the variations of the comparative lengths of the different phrases and expressions. By these steps it is not very difficult to assure ourselves, that a *shrine* and a *priest* are denoted by representations which must have been intended for pictures of objects denoted by them; and this appears to be the precise point of the investigation at which it becomes completely demonstrative, and promises a substantial foundation for further inferences. The other terms, *god* and *king*, are still more easily ascertained, from their situation near the name of Ptolemy.

The most material points of the three inscriptions having been thus identified, they may all be written side by side, and the sense of the respective characters may be still further investigated, by a minute comparison of the different parts with each other. The last line of the sacred characters, with the corresponding parts of the other inscriptions, will serve as a fair specimen of the result that has been attained from these operations. (Plate LXXVIII. M.)

In thus comparing the enchorial with the sacred characters, we find many coincidences in their forms, by far too accurate to be compatible with the supposition that the enchorial could be of a nature purely alphabetical. It is evident, for example, that the enchorial characters for a *diadem*, an *asp*, and *everliving*, are immediately borrowed from the sacred. But this coincidence can certainly not be traced throughout the inscriptions; and it seemed natural to suppose, that alphabetical characters might be interspersed with hieroglyphics, in the same way that the astronomers and chemists of modern times have often employed arbitrary marks, as compendious expressions of the objects which were most frequently to be mentioned in their respective sciences. But no effort, however determined and persevering, had been able to discover any alphabet, which could fairly be said to render the inscription, in general, at all like what was required to make its language intelligible Egyptian; although most of the proper names seemed to exhibit a tolerable agreement with the forms of letters indicated by Mr Akerblad; a coincidence, indeed, which might be found in the Chinese, or in any other character not alphabetical, if they employed words of the simplest sounds for writing compound proper names.

The question, however, respecting the nature of the enchorial character, appears to be satisfactorily decided by a comparison of various manuscripts or papyrus, still extant, with each other. Several of these, published in the great *Déscription de l'Egypte*, have always been considered as specimens of the alphabetical writing of the Egyptians, and certainly have as little appearance of being imitations of visible objects, as any of the characters of this inscription, or as the old Arabic or Syriac characters, to which they bear, at first sight, a considerable resemblance. But they are generally accompanied by tablets, or delineations of certain scenes, consisting of a few visible objects, either detached, or placed in certain intelligible relations to each other; and we may generally discover traces of some of these objects, among the characters of the text that accompanies them. A similar correspondence between the text and the tablets is still more readily observable in other manuscripts, written in distinct hieroglyphics, slightly yet not inelegantly traced, in a hand which appears to have been denoted by the term *hieratic;* and by comparing with each other such parts of the text of these manuscripts, as stand under tablets of the same kind, we discover, upon a very minute examination, that every character of the distinct hieroglyphics has its corresponding trace in the running hand; sometimes a mere dash or line, but often perfectly distinguishable, as a coarse copy of the original delineation, and always alike when it answers to the same character. The particular passages which establish this identity, extending to a series of above ten thousand characters, have been enumerated in the *Museum Criticum;* they have been copied in adjoining lines, and carefully collated with each other; and their number has been increased, by a comparison with some yet unpublished rolls of papyrus, lately brought from Egypt. A few specimens from different manuscripts will be sufficient to show the forms through which the original representation has passed, in its degradation from the *sacred* character, through the *hieratic*, into the *epistolographic*, or common running hand of the country. (Plate LXXVIII. N.)

It seems at first sight incomprehensible, that this coincidence, or rather correspondence, should not be equally observable in the two inscriptions of the Rosetta stone, which, if the enchorial character is merely a degradation of the sacred, must naturally be supposed to be as much alike as those of the different manuscripts in question; while, in reality, we can but seldom trace any very striking analogy between them. But the enchorial character, having been long used in rapid writing, and for the ordinary purposes of life, appears to have become so indistinct in its forms, that it was often necessary to add to it some epithet or synonym, serving to mark the object more distinctly: just as, in speaking Chinese, when the words are translated from written characters into a more limited number of sounds, it is often necessary, on account of the imperfection of the oral language, to add a generic word, in order to determine the signification, and to read, for example, *a*

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goose bird, when *a goose* only is written, in order to distinguish it from some other idea implied by a similar sound; and even in English we might sometimes be obliged to say *a yew tree*, in order to distinguish it from *a ewe sheep*, or *you yourself*, or *the letter u*. The enchorial character, therefore, though drawn from the same source, can scarcely, in this form, be called the same language with the sacred hieroglyphics, which had probably remained unaltered from the earliest ages, while the running hand admitted all the variations of the popular dialects, and bore but a faint resemblance to its original prototype. Indeed, if it had been completely identical, there could have been no propriety in repeating the inscription with so slight a change of form.

The rituals and hymns, contained in the manuscripts which have been mentioned, are probably either of higher antiquity than the inscription of Rosetta, or had preserved a greater purity of character, as having been continually copied from older originals. It is also remarkable, that, in one of these rolls of papyrus, engraved by Denon, the introduction is in the sacred character, and some of the phrases contained in it may be observed to be repeated in the subsequent part of the manuscript, which is in a kind of running hand, though somewhat less degraded than in most other instances.

It was not unnatural to hope, that the comparison of these different manuscripts would have assisted us very materially in tracing back all the enchorial characters to the corresponding hieroglyphics, as far as the parts of the respective inscriptions remain entire, and even in filling up the deficiencies of the sacred characters, where they are wanting; and something has certainly been gained from it with respect to the names of several of the deities; but on account of the differences which had crept in between the forms of the language, expressed by the sacred and the cursive characters, the advantage has hitherto been extremely limited. It seems, indeed, to have been a condition inseparable from the whole of this investigation, that its steps should be intricate and laborious, beyond all that could have been imagined from our previous knowledge of the subject; and that, while a number of speculative reasoners have persuaded themselves, at different times, that they were able to read through a hieroglyphical inscription in the most satisfactory manner, beginning at either end, as it might happen, the only monument that has afforded us any real foundations for reasoning on the subject, is more calculated to repress than to encourage our hopes of ever becoming complete masters of the ancient literature of Egypt; although it is unquestionably capable of serving as a key to much important information, with respect to its history and mythology; nor is it by any means impossible, that a careful consideration of other monuments already known, or of such as are now discovered from day to day, may enable us to detect a number of unknown characters, so situated with respect to others, which are already understood, as to carry with them their own interpretation, supported by a degree of evidence far exceeding mere conjecture. We are now to proceed to an enumeration of the principal characters, which have already been rendered intelligible.

Hieroglyphic Vocabulary.

Section VII.—*Rudiments of a Hieroglyphical Vocabulary.*

A. DEITIES. (Plate LXXIV.)

1, 2. The word God is always represented in the inscription of Rosetta, and often in many others, by a character resembling a particular kind of hatchet, which is delineated repeatedly at Medinet Abou, as a weapon in the hands of warriors, and is even found among the modern weapons engraved by Denon, (*Plate XCV.*) This character is frequently exchanged, in parallel passages of different manuscripts, or of the same, for a figure sitting or standing without distinct arms or feet, either with a human head or a hawk's head; or sometimes, by a deviation from the correct nature of an abstract or general term, with the heads of different animals, according to the character of the deity to whom it is applied. But in the inscription of Rosetta, this symbol appears to be exclusively appropriated to the gods in their JUDICIAL capacity; and it occurs several times in the term meaning *lawful*, n. 151. This interpretation is also fully justified by the testimony of Plutarch, that " the figures of *judges* were represented without hands."

3. A Goddess is denoted by the hatchet or sitting figure, with the addition of the female characteristic, generally as a termination; but sometimes the simple character is applied to gods and goddesses indifferently. The semicircle and oblique oval, distinguishing the feminine gender, are observable in almost all well marked names of females found in different tablets, and the crooked line, which corresponds to them, in the enchorial character of the stone of Rosetta, may be distinguished at the end of each of the five names of females that occur in the inscription, n. 58, 60, 69, 70, 71. Occasionally the characteristic is prefixed, and this position agrees better with the Coptic TI, which distinguishes a female: nor must we omit to observe, that a semicircle seems to answer to the T in some other cases, and is always expressed in the running hand by the character which Mr Akerblad calls T or D, and which is also exactly the Syriac T. The asp or basilisc standing erect is a symbol of divinity, which occurs on the green sarcophagus, called the tomb of Alexander, and elsewhere, instead of the more ordinary character. In a few instances, the semicircle is found without the oblique oval, (n. 57.)

4. The plural, Gods, is formed by repeating the character three times, or by placing three dashes after, or sometimes before it. In the enchorial inscription, the dashes are united into a crooked line, and are placed in this instance both before and after the principal character; but, in general, the second line is straighter than the first. The dual is expressed by a double character only, (n. 57.)

5. A winged globe, sometimes flattened, as if intended for an egg, but often coloured red, is very commonly represented as hovering over a hero, and generally occupies the lintel of some of the doors of a temple. A globe nearly similar is also sometimes connected with the head and tail of a serpent, bearing the symbol of *life*, which is the common charac-

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teristic of a deity. There can, therefore, be no objection to considering these representations as belonging to the *Agathodæmon*, or *Chnuphis* of the Greek authors; and the same symbol is sometimes found in the text of an inscription, in the neighbourhood of the pictural representation; so that its sense may be considered as tolerably well ascertained; but the evidence being somewhat indirect, the name is inserted in smaller characters, the same distinction being also observed in other instances. Mr Bruce informs us, in his letter to Wood, that in some parts of the Tunisian dominions, serpents are still regarded as a kind of good angels. The Chnubis, or Chnumis, of the amulets, is generally represented as a serpent with a human head, or with that of a lion; and the former combination is not uncommon in the tablets of the manuscripts; but the hieroglyphic denoting it is a long undulated line, totally distinct from this character.

6. The symbol, often called the *Hieralpha*, or sacred A, corresponds, in the inscription of Rosetta, to PHTHAH, or Vulcan, one of the principal deities of the Egyptians; a multitude of other sculptures sufficiently prove, that the object intended to be delineated was a plough or hoe; and we are informed by Eusebius, from Plato, that the Egyptian Vulcan was considered as the inventor of instruments of war and of husbandry. In many other inscriptions, the pedestal or pulley is used indifferently for the plough. Horapollo tells us, that Vulcan was denoted by a beetle; and the Monticœlion obelisc of Kircher has the plough on three sides, and the beetle on the fourth: Horapollo, however, is seldom perfectly correct; and the names of different divinities are frequently exchanged on the banners of the same obelisc; nor is there any clear instance of such an exchange of the plough for the beetle as occurs perpetually in the case of the pedestal. The beetle is frequently used for the name of a deity whose head either bears a beetle, or is itself in the form of a beetle; and in other instances the beetle has clearly a reference to generation or reproduction, which is a sense attributed to this symbol by all antiquity; so that it may possibly sometimes have been used as a synonym for Phthah, as the father of the gods. The plough is very rarely found as the name of a personage actually represented, and it is difficult to say under what form the Egyptian Vulcan was chiefly worshipped; but on the tablet of a Horus of bad workmanship, belonging to the Borgian Museum, he is exhibited with a hawk's head, holding a spear; while in the great ritual of the *Déscription de l'Egypte*, Ant. II. Pl. 72. Col. 104, he seems to be represented by a figure with a human head; an exchange, however, which is very common in some other cases, with respect to these two personifications, though it does not extend to the substitution of the heads of different animals for each other.

7. AMMON, the Egyptian Jupiter, is sufficiently identified by a combination of evidence of various kinds, although no single link of the chain extends very far. A figure with a ram's head is denoted, both on the green sarcophagus, and on the temple at Elephantine, by a water jar, sometimes, but not always, accompanied by a bird: now a water jar of this form is constantly converted, in the running hand of the manuscripts, into a character like a z; and this character, in the enchorial text of Rosetta, is made to express the name of Jupiter; a fact which confirms the testimony of the Greek authors, who consider the Egyptian Jupiter as having been represented with a ram's head. A similar figure is found at Edfou, or Apollinopolis Magna, and at Esne or Latopolis: the temple at Edfou seems to have been dedicated by Amenophis or Memnon; and he appears to be called *lover of Ammon*, that is, MIAMUN, which is not unlike the name MEMNON.

8. The common astronomical diagram for the sun, ⊙, seems to have been adopted by the Latin astrologers from their masters in Egypt; since it is not very probable that both should have employed a point in the centre of the circle, without some communication with each other; the circle alone having been mentioned by some of the Greek authors, who say, that it was the symbol of the sun. The deity RE or PHRE is indicated by this character followed by an upright bar; and the circle is often enveloped in the coil of the body of a serpent; an oval and an arm also often follow the circle. The enchorial name of the sun is extremely like that which corresponds in the manuscripts to this hieroglyphic: and a similar circle, with rays diverging from it, though seldom exactly in straight lines (N. 160), is used in the sense of "enlightening," or "rendering illustrious;" and it has also been observed by some of the French, who have been in Egypt, to stand in several inscriptions with a manifest reference to light. The circle occurs also as a part of the terms month and day (N. 178, 179). In the great Hieratic Ritual, and in some other manuscripts, this name of Phre occurs very frequently under or near the tablet which contains a representation of the sun shining, as well as under the next to it, which exhibits a head rising out of a lotus, an emblem, mentioned by Plutarch as relating to the sun, which here is made to spring from the pedestal (No. 6), as the sun is said to have been the offspring of Phthah. Whatever plant this lotus may have been, it certainly does not much resemble the nelumbo of the east, which some imagine to have been the original emblem of fertility. The name Phre is almost the only intelligible combination of letters that ever occurs on the Abraxas or amulets; and the monster, to which it relates, has generally radiations from its head, and is surrounded by six stars. The tablets of the sun in the manuscripts exhibit also little genii worshipping him, each of which is always marked "*star god.*"

9. The name of RHEA may, without impropriety, be assigned to a female personage very commonly accompanying the sun, and distinguished by many of his attributes; although the evidence would have been somewhat more conclusive, if the name had been found attached to the figure of the mother in the tablet of the birth of Isis. On the coffins of the mummies, this personage is generally represented with outstretched wings; in other tablets without wings: but she carries in both cases a circle on her head, emblematic of the sun. If we considered the analogy of the hieroglyphic name only,

we should be disposed to interpret it as meaning the wife or sister of Ammon.

10. Ioh, the Moon, is not a deity of very frequent occurrence; but the character is easily interpreted, both from its form, and from its being found, in a different position, as a part of the word month. (No. 179.) At Dendera, this character is accompanied by the epithet God, and without any female termination, as well as in several passages of an epistolographic manuscript sent home by Mr Bankes; a circumstance which is favourable to the opinion that Ioh was considered as masculine in mythology as well as in grammar, just as Men or Lunus was sometimes made masculine by the Greeks and Romans; the fact, however, is not absolutely decisive of this question, since the character is not accompanied by the delineation of any personification of the deity.

11. The historical description of the god Thoth, or Hermes, as the scribe, or secretary of Osiris, and the inventor of writing, sufficiently identifies him with the person who is perpetually represented standing before Osiris, and writing with a quill or a style on a square or oblong tablet. He has always the head of an ibis, and this bird, standing on a perch, constitutes his hieroglyphical name, as the ibis is known to have been the emblem of Thoth; the hieroglyphic for letters, N. 103, is also frequently found among his titles; and all these circumstances abundantly confirm the opinion of his true character, which Zoega and others have already advanced from conjecture only. The enchorial name is much disfigured, but the manuscripts exhibit a character which may serve to supply the connecting link, and another abridgment of the name which deviates still more widely from the original, being simply the common substitute for a feather, which here seems to stand for the whole bird, or perhaps merely for a feather which is often found projecting from the end of the perch. Next to Osiris, we find that Thoth is of more frequent occurrence than any other deity in the great ritual; and it is probable that the mummies of the ibis, which are so commonly found, were preserved in honour of him. The semicircle with two oblique dashes, under the perch, seems to correspond to the epithet " great and great" of the Rosetta inscription; this character being generally significative of a dual. The scale, with eight dashes, and two other characters, is also very frequently employed as an epithet, and sometimes as a synonym of Thoth; it seems to mean " dispenser of the eight treasures, or laws, of the country;" for Diodorus informs us that the principal laws of Egypt were contained in eight books.

12. The name of Osiris is found, with the epithet " divine," in a great majority of all the mythological inscriptions that have yet been discovered; so that this circumstance alone is sufficient to show that it must have been that of the principal deity of Egypt. The enchorial character of the inscription of Rosetta is readily identified, and it agrees perfectly well with that of the manuscripts, answering to the eye and the throne; so that the manuscripts here completely supply the want of that part of the stone which contained the name in the sacred character. This name is also universally annexed to the great figure which is found at the end of almost all the manuscripts, and on the coffins of mummies, holding a hook and a whip or fan, and of which the small detached images are also extremely common. In the sculptured inscriptions, the eye generally precedes the throne; in the running hand of the manuscripts, and on the coffins of some mummies, apparently of later date, the eye sometimes follows. Plutarch had perhaps been rightly informed respecting this character, but by a mistake, which was easily committed from a want of perfect recollection, he has called it " an eye and a sceptre;" and this combination has not been recognised as the name of a deity, though a symbol something like it occurs in some of the tablets. The pictured delineation of Osiris has indifferently a human head or that of a hawk; but never that of any other animal. The tear, N. 100, seems also sometimes to have been used as an emblem of Osiris, as well as of Apis and Mneuis, who were considered as representations of him. The name is found perpetually on monuments of all kinds as an epithet of a departed person; and this is one great reason of the frequency of its occurrence.

13. Arueris, the Apollo of the Egyptian mythology, is sufficiently identified by the comparison of various inscriptions with the fragment of Hermapion, preserved by Ammianus Marcellinus, as the translation of the inscription on a particular obelisc, with which, however, it does not exactly agree, although its style completely resembles that of the Egyptian inscriptions in general, and the beginning corresponds perfectly well to the beginning of almost all the obeliscs in existence, supposing only the hawk to be part of the name of Arueris; which is, besides, an inference extremely probable, from the tablets of several of the obeliscs, representing a deity characterized by a hawk with two bars, and styled the son of another personage who seems to be the sun, as Apollo is called by Hermapion, and Arueris by Plutarch. Mr Hamilton has also given us a Greek inscription at Ombos, in which Arueris is made synonymous with Apollo; although the hieroglyphics, which have been copied from this temple, afford us no assistance in the inquiry. The sort of ladder, which occurs as a second name of Arueris, is found prefixed to the hawk in its usual form, on the obelisc at Wanstead figured by Gordon, and on the frize of Montagu and Ficoroni (*Hierogl. Eg. Soc.* 7 Eo p; 9 Lk); and it follows it on a statue of Pococke (Vol. I. p. 212). Arueris is commonly represented either with a human head, or with that of a hawk, bearing a disc, as that of the sun is also generally depicted; and in Plate 138 of Denon, the two deities seem in some measure confounded. The Egyptian name may be interpreted " evening sun," as emblematic of the repose of victory; ER RUHI RE.

14. Isis, the sister and wife of Osiris, is very naturally denoted by the throne with the female termination; and, in more than one instance, the female figures, which have been long recognised as representations of Isis by other attributes, are distinguished by bearing the throne on the head, which is a common

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mode of characterizing the different personages of the tablets. The manuscripts, again, enable us to discover the connecting link between the sacred and enchorial characters, and to supply the defects of the stone of Rosetta; though the resemblance is somewhat too imperfect to have satisfied us without their assistance. The goddess, thus distinguished, is very generally represented as standing at the head or feet of a corpse, with another female figure opposite to her; and we find the same personages at the opposite ends of several of the sarcophagi; so that the analogy of Isis to Proserpine, and her character as the guardian of the remains of the dead, are sufficiently consistent with these representations. On a scarabaeus, brought from Egypt by Mr Legh, and in a hieroglyphic inscription at Philae, she appears to be called the offspring of Phthah. She often bears in her hand a sceptre forked at the foot, with a lotus for its head, while Osiris has more commonly a similar sceptre with the head of an animal; but these attributes are sometimes assigned to other deities. In one of the boats on the green sarcophagus, and on Letheuillier's mummy, both in the British Museum, she is personified as a basilisc. Mr Hamilton has published some Greek inscriptions from Philae, and from the small temple at Dendera, which show that Isis was the principal deity of these temples; and the hieroglyphics, as far as they have been copied, are precisely of the same import. The great temple at Karnak seems also to have been dedicated to Isis, and probably the small southern temple. On a medal, of Greek workmanship, in the Borgian Museum, we have a figure of Isis, with the word THĔSI, which may probably have been intended for TIESI, the Egyptian name with the feminine article.

15. The constant companion of Isis can be no other than NEPHTHE; her name somewhat resembles that of Isis, with a scale or basin annexed to it, but the square surrounding the throne is completed, and the scale is sometimes detached from it, with a circle interposed; and, in this form, the name comprehends one of the characters denoting a temple. (N. 87.) It seems also to be a head of Nephthe that is found at Dendera and elsewhere, supporting a little temple or shrine, in the place of the capital of a column; nor is it improbable that the great temple at Dendera was dedicated to Nephthe; for the Greek inscription has Aphrodite, which is mentioned by Plutarch as a synonym of Nephthe. It is true that the birth of Isis is represented on one of the ceilings; but it does not, therefore, follow that Isis was the principal goddess of the temple. A head bearing a shrine is not an uncommon ornament of a sistrum; and this agrees perfectly with the remark of Plutarch, that the head of Nephthe, as well as that of Isis, was sometimes represented on these instruments.

16. The emblem of a bird in a cage, which is often found in the manuscripts, accompanied by the figure of a child, seems to indicate the character of a *nurse*, and may without inconvenience be interpreted as relating to the goddess *Buto*, the nurse of Horus and Bubastis; though it would perhaps have been more correct to engrave the name in smaller letters, as denoting some degree of uncertainty. On the sarcophagus called the Lover's Fountain, in the British Museum, she is delineated with a hawk's head; in the western temple at Philae she has a human head with a horned head dress, and she sits near Isis and Horus; a circumstance which strongly confirms the propriety of the denomination.

17. The enchorial name of HORUS seems to be derived from the figure of a hawk followed by the character denoting Isis; an arrangement which agrees very well with the supposition that his usual denomination was HORSIESI. The figure of the infant (N. 133), the chain, and the knot, clearly form a part of the name on a Horus engraved by Montfaucon (*Ant. Expl.* II. p. 302), and on an obelisc from Bosc in the Supplement of the same work. In some cases a feather, following the infant, seems to supply the place of the bird, as in Caylus, Recueil, IV. Pl. 13.

18. PAAMYLES, mentioned by several authors as the Priapus of Egypt, is sufficiently distinguishable by his usual attributes. He is often figured with one hand only, which is elevated towards the angle of a kind of whip or fan, suspended above him. At Edfou he is once denoted in an inscription by a figure like that of the tablets; and in another place by a distinct name, much resembling that of a female deity, found on some of the cases of the mummies, who might consequently be called *Paamylia*.

19. The Nile seems to have been reckoned among the deities of Egypt, and the character which appears to be appropriate to a river (N. 82) is found occasionally in the tablets, followed by a vessel and a spiral (N. 7 or 9, and 201), which seem indeed to make a part of the name, and accompanied by epithets of respect. This character has already been considered by Kircher and others as representing a Nilometer; and the deity in question can only be distinguished by the name NILUS.

20. The sacred characters denoting APIS are pretty clearly determined by the triple inscriptions; the enchorial name is perfectly so. If, however, any doubt remained on the subject, it would be removed by an examination of the inscriptions on four vases found by Paul Lucas (*Voyage dans la Turquie*, 2 v. 12. Amst. 1720, Vol. I. p. 346) at Abousir, the Busiris of the ancients; that is, the BE OSHIRI, or sepulchre of Osiris, as Diodorus very properly translates it. There is a received tradition that Apis was worshipped and buried here, and Lucas established its truth by finding the mummy of a bullock in the catacombs. Now, all the inscriptions on the vases end with a bullock, preceded by this character, though the angles are turned in a different direction from those of the inscription of Rosetta: so that the two forms of the character seem to have been used indifferently. With this latitude, we have no difficulty in identifying the name as it occurs in almost every line of the inscriptions on the great sarcophagus of granite, formerly at Cairo, called the Lover's Fountain, and now in the British Museum; which, there is some reason to suppose, from the frequency of this name, may have been intended for receiving a mummy of the bull Apis; although it must be confessed, that, in several other monuments, the names of the deities are introduced in a manner

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somewhat similar, with an evident relation to the designation of some human being, whom they are intended to commemorate.

21. The enchorial name of MNEUIS is very completely ascertained by the inscription of Rosetta: and from a comparison of different passages in the manuscripts, there is reason to infer, that it was intended as an imperfect representation of a basilisc and a tear, emblems which are repeatedly found in the great ritual, connected with the figure of a bullock.

21*. The sacred cow, in the manuscripts sent home by Mr Bankes, is denoted by a serpentine line with two dots, followed by the term goddess. We may venture to distinguish her by the temporary name *Damalis:* that of Io would imply too great identity with the Greek mythology. (Plate LXXVIII. L.)

22, 23. In the tablets representing the judgment of the deceased, we generally find two personages standing by the balance, and apparently weighing his merits; one with the head of a hawk, the other with that of a wolf; seeming to officiate as the good and evil genius of the person. The former, denoted by a hawk with a bar, and sometimes also a spear, appears, from various monuments, to have some relation to the sun or to Horus, and may therefore be called *Hyperion:* the other is often observed to be employed in the preparation of a mummy, and may be called from this occupation *Cteristes*, or the embalmer. He is also frequently represented on the coffins of mummies, and elsewhere, under the form of a wolf, sitting on a kind of altar: and he seems to be an immediate minister of Osiris. His hieroglyphical name is a feather, a wavy line, and a block; or a hatchet under a sort of arch.

24 . . 27. Under the bier on which a mummy lies, and in many other situations near the person of the deceased, we find representations of four deities who seem to be concerned in the operation of embalming, and who might even be supposed to preside over the different condiments employed, their heads frequently serving as covers for four jars, of the kind sometimes called Canopi: they may also very properly be considered as attendants of Isis, who seems to be a still more important personage on such occasions. The first of the four has generally a human head, and may be called *Tetrarcha;* his name contains a sort of forceps, and a broken line: the second and third have respectively the heads of a dog or baboon and of a wolf: and they agree very satisfactorily with the well known character of ANUBIS, and with that of MACEDO his companion, mentioned by Diodorus as having a wolf's head, whose name may possibly have some relation to MANCHAT, "a worker in silver," as that of Anubis has to NUB, "gold." The hieroglyphic name of Anubis differs from that of Apis only in having the angles directed immediately upwards, a circumstance which is not so indifferent to the signification as it at first appeared; that of Macedo has a vulture with a star, and sometimes an arm instead of the vulture. The fourth of these deities is represented with the head of a hawk, and may therefore be called *Hieracion:* and he is denoted by a water jar, with three plants, somewhat resembling leeks or onions.

28 . . 32. Among the many hundreds of deities who are represented in various inscriptions and sculptures, some of the most remarkable are two personages with the heads of wolves, the first characterized by a sort of raised frame or banner, and a pair of horns, which may be expressed by the pseudonymous or temporary term *Cerexochus*, and the second by a half bow, and a sword or knife, whence he may be called *Bioxiphus;* a figure with a human head, generally wearing a feather on it, and denoted by a broad feather reversed, which is implied in the name *Platypterus;* another wearing a cap with a whip in it, who may be called *Mastigias;* and a fifth in the form of a female, distinguished by a bier, who, at Edfou, bears a tear on her head, and who may be called *Soraea*.

B. KINGS.

33, 34. We are informed by Pliny, that the *Alexandrian* obelisc was erected by Mesphres or Mestires, the reading of the different manuscripts being different; and since no king of the name Mestires is mentioned by other authors, we may consider this *Mesphres* as the Mephres or Mesphris who succeeded his mother Amersis about 1700 B. C., or perhaps a century or two later. The hieroglyphical name of his father contains that of the god Thoth, and may therefore possibly have been intended for the *Thuthmosis* of the chronologers, who is said to have been the grandfather of Mesphres. The obelisc at Alexandria, now called Cleopatra's Needle, like almost all others which contain three lines on each side, exhibits different names in the middle and the outer lines: from this circumstance, as well as from the greater depth of the sculptures, which is generally observable in the middle line, there is reason to suppose that this line stood at first alone, and that the two on each side were added by a later monarch. The *Lateran* obelisc, however, is remarkable for exhibiting the name of Mesphres on all the lines of the different sides. The *Constantinopolitan* obelisc has only one line on each side, with the name of Mesphres the son of Thuthmosis. The same name is also found on the gateway of the fifth catacomb, at Byban El Molouk: on a pillar of the palace at Karnak, and in a splendidly coloured bas relief on one of the interior architraves of the gallery; as well as on a seal of Denon, Pl. 98, and on some others brought from Egypt by Mr Legh.

35. The *Isean* obelisc of Kircher has a "son of Mesphres, favoured by Phthah;" we must therefore distinguish this king by the name *Misphragmuthosis*, who is recorded as the son and successor of Mesphres.

37 . . 39. A multitude of ancient Greek inscriptions identify the statue of Memnon, celebrated by all antiquity for its musical powers, which, Strabo says, he witnessed in person, though he could not very positively decide that the sound proceeded from the statue, rather than from some of the bystanders. In one of the inscriptions we find the word *Phamenoth*,

not as a date, but as a synonym of Memnon, which must be considered as identical with the Phamenoph given by Pausanias as his Egyptian name, and with the Ammenoph or Amenophis of Manetho or others, which differs from it only as wanting the article. There is, however, some doubt to which Amenophis this statue properly belongs. Manetho makes Memnon the eighth king of the eighteenth dynasty, who may be called Amenophis the Second; but Marsham brings him down to the Ammenephthes of Manetho, or Amenophis the Fourth, and principally because he thinks that only a successor of Sesostris could have been well known in Asia; and he even supposes him to have been later than Homer, who, he says, never mentions him, though Hesiod calls him the son of Tithonus and Aurora. But, in fact, the name of Memnon does occur in the Odyssey, where Ulysses alludes to his beauty in a conversation with the shade of Achilles; and Hesiod could scarcely have mentioned a king as descended from a deity, that was not considerably earlier than his own time; so that the tradition of Manetho seems to be preferable to the mere conjecture of Marsham. At the same time, we cannot well call him Memnon the son of Thuthmosis, the name of the father not agreeing with that of this king; and there is another circumstance which seems to lead us to the third Amenophis, intermediate between these two extremes, who was the son of Ramesses Miamun, or Ramesses the lover of Ammon; which is, that Amenophis himself appears to have built a temple to Ammon in the isle of Elephantine, and is called Miamun in several of the hieroglyphical inscriptions still existing there; so that there is little doubt that the name Memnon must have been derived from Miamun. Besides the different statues of the Memnonium, we find monuments of the same personage in almost every part of Egypt, though they are much more frequent at Thebes and in its neighbourhood. The name is marked on all the lion headed goddesses of black granite which are now in the British Museum, and on some others which are in possession of Mr Bankes. The first of this series having been purchased, as Bruce informs us, for a large price, by Donati, for the King of Sardinia, the inhabitants were induced to take some pains in digging the others out of the sand. The building, called by the French the tomb of Osymandyas, bears also the name of Memnon; and it is remarked by Strabo, that Memnon and Ismendes may probably have been the same person. The name is also found in the grottos at Byban El Molouk, on some statues representing Osiris, and in some inscriptions at Ombos, as well as on a seal of Denon, Pl. 98. Mr Bullock has presented to the British Museum a scarabæus of very hard stone, on which we find the name of Memnon, together with that of his father and mother, whom we may call, in order to preserve the mythological analogy, *Tithous* and *Eoa*, although without asserting that this Tithous was the builder of the labyrinth, which some authors have attributed to a king named Tithoes, and others to Ismendes. The mother's name occurs also alone, as "the goddess mother," on the back of a beetle in Gordon's Mummies, Plate 22; a circumstance which removes the doubt, that might otherwise arise, from the want of the female termination in the name; the father's is found on a square seal, in the possession of Mr Legh. There is another copy of the inscription of Mr Bullock's scarabaeus, on a scarabaeus belonging to Mr Palin, which had long been used by a Greek priest at Athens, for stamping the paschal bread. (*Dubois*, Pierres Gravées, Par. 1817, Pl. V. N. 5.) The beautiful head, lately brought from the Memnonium to the British Museum, has only a part of the father's name remaining, which does not appear to be that of the father of Memnon, though the first three characters are the same; but the fourth is the pedestal representing Phthah; and a similar name is found on some other colossal statues and obeliscs remaining in Egypt, as well as on a smaller figure of red granite, brought by Mr Hamilton from Elephantine.

39. In the principal name on the obelisc at *Karnak*, the final scale of the name of Memnon is exchanged for a pair of arms stretched upwards; a variation which may be expressed by calling it Amenuses or *Amenses*, from Shesh, a pair. The father's name is also a little like that of Tithous; but, that the difference is constant, may be inferred from its separate occurrence on a seal brought home by Mr Legh, a lion's head making a part of it in both instances. The true name and date of this personage must be considered as wholly unknown; though the resemblance of the name to Memnon makes it convenient to place them together. In Mr Boughton's minute golden image, engraved in the Archæologia, the name appears to be the same, but with the synonymous substitution of the hatchet for the judge.

40, 41. The obelisc at *Heliopolis* has every mark of considerable antiquity, and the shortness and simplicity of its inscription is appropriate to a remote period. Pliny says, that Mitres or Mestires first erected obeliscs at Heliopolis; he also mentions Sothis, and apparently Ramesses, as having left similar monuments of their magnificence in the same place. The principal name on the obelisc now remaining at Matareah may also be observed in several other inscriptions, but with the substitution of two other names for that of the father; so that the name of the son must probably have belonged to many different individuals; a circumstance which, as well as the sounds belonging to the different characters, agrees very well with Ramesses, for we have re, "the sun," mes, "a birth," and shesh, "a pair;" so that we may venture to call it *Remesses;* and we may take *Heron* for the father of the first Remesses, from Hermapion, though it is possible that he may be the Armais of Manetho; but we have scarcely sufficient evidence to appropriate to him that name. Another Remesses seems to have been a son of Sesostris; a third Ramesses follows Ammenephthes in Manetho, and agrees with the Rhampsinitus of Herodotus, and the Remphis of Diodorus, who is mentioned as the successor of Proteus; and this may, perhaps, have been the Remesses of the frizes of Montagu and Ficoroni (Hierogl. 7 Ou. 9 If), who seems, from the resem-

blance of the different parts of the work, to have been nearly contemporary with Sesostris. (Hierogl. 7 H. I.) There is also another Remesses on the Lions at the fountain of Aqua Felice, near the baths of Diocletian at Rome, the name of whose father is a little like the name supposed to belong to Arsinoe, N. 60.

42, 43. The obelisc, erected by Augustus in the *Campus Martius*, is said, by Pliny, to have been the work of Sesostris; and there are sufficient documents of its identity with that which had long remained buried near the Monte Citorio, and of which figures have been given by Zoega and others. The inscription was supposed, in the time of Pliny, to contain a compendium of the physical and philosophical learning of the Egyptians; but, in order to make this opinion credible, it would be necessary to admit that the princes of earlier days entertained very different ideas from those which have since been prevalent, respecting the comparative importance of the abstract sciences, and of national prosperity, and martial glory. If Sesostris was the son of Amenophis, he cannot have been the reigning king mentioned in this obelisc: but it may safely be attributed to *Pheron* the son of *Sesostris*, who, according to Herodotus, erected two obeliscs; and the occurrence of the name of Sesostris, as the father, may be considered as sufficiently conformable to the testimony of Pliny. The same names are found, with a slight variation, on a small statue of basalt, very highly finished, now standing in the British Museum; and Denon has copied them from an inscription in the Memnonium. (Pl. 118.)

44. *Nuncoreus*, according to Diodorus, was another son of Sesostris; his name occurs also in Pliny, and we may consider him as the son of Sesostris mentioned in Mr Montagu's frizes. The name is also found at Philae, and, with a slight variation, on an altar of basalt, figured by Caylus (Rec. I. Pl. 19), now in the king's library at Paris. The remains of the same name may also be observed on a block, apparently of white sandstone, in the British Museum, which is figured by Norden, in its old situation, as a part of the foundations of Pompey's Pillar at Alexandria, and it occurs on a fragment of a statue brought by Mr Hamilton from Thebes.

45. The name of *Proteus*, or Certus, otherwise Ammenephthes, is only known as the predecessor of one of the kings named Ramesses, and we may safely employ it for the father of the Remesses of the frizes of Montagu and Ficoroni, the whole of which are remarkable for the excellence of their workmanship.

46, 47. Until we obtain evidence of a more positive nature, we may give to the two kings mentioned on the sarcophagus of green breccia, the names of *Amœnupthes* and *Anysis*, supposing them to have lived about the time of Amenephthes, or Amenophis the Fifth, and his successor Osochor. The father's name might, without difficulty, be read "Mænuphthah," supposing some titles to follow it. There are also two obeliscs of the same king, brought from Cairo, which stand near the sarcophagus in the British Museum, and the style of the workmanship somewhat resembles that of the times of Sesostris, and his immediate successors. It has been observed, that neither of the names can well be Alexander's, since that of the father is repeated much more frequently than that of the son, which could not have happened if it had been meant for Philip; and Alexander had no son who could have been mentioned in his sarcophagus. Nor is it at all probable, that Alexander should have erected any obeliscs at Memphis or in its neighbourhood. The god Ammon is no where mentioned among the titles of the king, and holds only an inferior rank among the innumerable deities represented in the tablets. We find both the names, without any addition, on a dovetail of copper, engraved in Lord Valentia's *Travels*, which was found at Behbeit, the Atarbechis or Aphroditopolis of the ancients, situated on the branch of the Nile that runs to Damietta.

48. . . 50. We learn from Pliny, that the *Flaminian* obelisc, now standing near the Porta del Popolo at Rome, which was the smaller of the two formerly in the Circus Maximus, placed there by Augustus, and used as the gnomon of a dial, was the work of Senneserteus or Semnesyrtaeus, who reigned in Egypt at the time that Pythagoras visited it. This king seems to have been the same with Psammuthis or PSAMMIS; and the authority of the evidence is so much the stronger, as the period in question is not extremely remote. The father of Psammis, according to Herodotus, was Necos or NECHAO. The two names occur on all the middle lines of the obelisc; and that of the father on the pillar of a colossal Isis in the Supplement of Montfaucon: the *Sallustian* obelisc, which seems to have been partly copied from the Flaminian, has them both. In the middle lines of both the obeliscs at *Luxor* we find a name much resembling that of Psammis, which we may therefore call *Psammetius*, conjecturing that it may have belonged to Psammetichus, who reigned a little earlier: the father's name is not unlike in its import to that of Nechao, both implying "approved by Phthah;" and it is remarkable, that in Manetho's series, the predecessor of Psammetichus is also Nechao.

51, 52. Among the most common of all the names of the kings of Egypt, on a great variety of monuments, are those which were mistaken by Kircher for a sort of amulets or charms, which he denominated the Mophthomendesian tablets. They occur alone on three small obeliscs only, the *Medicean*, the *Mahutean*, and the *Monticœlian* of Kircher; but they are found in the external lines of the Alexandrian, the two at Luxor, the Flaminian, and the Sallustian, while none are ever found exterior to them. They must, therefore, necessarily be attributed to one of the latest kings of Egypt; and there is none so likely to have made such a display as AMASIS, a man of considerable magnificence, and at the same time of a cautious and artful character: indeed, we have no alternative left but to choose between him and some of the kings who revolted against the Persians, and who do not appear so likely to have had leisure or finances for public works of splendour. His father's name, like that of Nechao, contains the character denoting Vulcan, and it may be called *Maenuphthes;* but he was not the son of a king. Both the names are found in one of the middle lines

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of the Flaminian obelisc; and on that side the king is represented in the tablet as doing homage to his predecessor, who occupies the place of honour on the other sides. The father's name seems to occur on the belt of a colossal statue in the palace at Karnak. On a fragment of stone in the British Museum, the names are repeated in various directions, as if it had belonged to a floor or a ceiling: they also occur on a statue, considerably mutilated, in the attitude of kneeling; and in Montfaucon's Supplement, on the back of a colossal Isis, which seems also to have been begun by Psammis. On the eastern colossus at Luxor, there is a name which might be taken either for that of Amasis or for that of the pseudonymous Psammetius; but the sitting figure is somewhat different: the victor in the naval combat at Medinet Abou, who appears also frequently at Ombos, considerably resembles them both. Lord Mountnorris has a rough seal with the name of Amasis only, the epithet God being prefixed in a smaller character. The names also occur on a small obelisc lying at Tsan, the ancient Tanis, of which a sketch was brought home by Dr Merion.

53, 54. We find at Karnak the name of a king somewhat like Psammis, that of his father resembling a compound of Ptolemy and Berenice. Perhaps they are not very correctly copied, but they may stand, under the temporary names of *Discozygus* and *Ptoleberius*, as specimens, somewhat singular, of a mixture of different dynasties; and in this point of view they may be placed between the old Egyptian kings and their Grecian conquerors.

55. (Plate LXXV.) The name of ALEXANDER has not yet been identified in the sacred characters; but it will appear hereafter, that a knowledge of the enchorial form may possibly contribute very materially, at some future time, to assist us in determining it.

56. There can be no doubt whatever respecting the signification of the name of PTOLEMY, as it occurs on the stone of Rosetta; but it is not quite so easy to determine its identity in some other cases, where it may possibly have been modified by contraction, mutilation, or combination. In this and a few other proper names, it is extremely interesting to trace some of the steps by which alphabetical writing seems to have arisen out of hieroglyphical; a process which may indeed be in some measure illustrated by the manner in which the modern Chinese express a foreign combination of sounds, the characters being rendered simply "phonetic" by an appropriate mark, instead of retaining their natural signification; and this mark, in some modern printed books, approaching very near to the ring surrounding the hieroglyphic names. The enchorial name of Ptolemy appears at first sight to be extremely different from the hieroglyphical; and it would have been impossible to deduce the one from the other, without a knowledge of the epistolographic forms of the separate characters, as ascertained by a comparison of the manuscripts. The beginning and end are obviously parts of the ring, which, in the sacred character, surrounds every proper name, except those of the deities. The square block and the semicircle answer invariably in all the manuscripts to characters resembling the P and T of Akerblad, which are found at the beginning of the enchorial name. The next character, which seems to be a kind of knot, is not essentially necessary, being often omitted in the sacred characters, and always in the enchorial. The lion corresponds to the LO of Akerblad; a lion being always expressed by a similar character in the manuscripts; an oblique line crossed standing for the body, and an erect line for the tail: this was probably read not LO but OLE; although, in more modern Coptic, OILI is translated a ram; we have also EIUL, a stag; and the figure of the stag becomes, in the running hand, something like this of the lion. The next character is known to have some reference to "place," in Coptic MA; and it seems to have been read either MA, or simply M; and this character is always expressed in the running hand by the M of Akerblad's alphabet. The two feathers, whatever their natural meaning may have been, answer to the three parallel lines of the enchorial text, and they seem in more than one instance to have been read I or E; the bent line probably signified great, and was read OSH or OS; for the Coptic SHEI seems to have been nearly equivalent to the Greek SIGMA. Putting all these elements together we have precisely PTOLEMAIOS, the Greek name; or perhaps PTOLEMEOS, as it would more naturally be called in Coptic. The slight variations of the word in different parts of the enchorial text may be considered as expressing something like aspirations or accentuations.

57. The appellation SOTERES, as a dual, is well marked in the inscription of Rosetta, and the character, thus determined, explains a long name in the temple at Edfou, which must mean "the two saviour gods," with various titles of honour, such as "the agents of Phthah, the emblems of triumph, the approved of Phre, the favoured of the Nile, the venerable consorts in empire."

58. The wife of Ptolemy Soter, and mother of Philadelphus, was BERENICE, whose name is found on a ceiling at Karnak, in the phrase, "Ptolemy and . . Berenice, the saviour gods." In this name we appear to have another specimen of syllabic and alphabetical writing combined, in a manner not extremely unlike the ludicrous mixtures of words and things with which children are sometimes amused; for however Warburton's indignation might be excited by such a comparison, it is perfectly true that, occasionally, "the sublime differs from the ridiculous by a single step only." The first character of the hieroglyphic name is precisely of the same form with a basket represented at Byban El Molouk, and called, in the description, "panier à anses;" and a basket, in Coptic, is BIR. The oval, which resembles an eye without the pupil, means elsewhere "to," which in Coptic is E; the waved line is "of," and must be rendered N; the feathers I; the little footstool seems to be superfluous; the goose is KE, or KEN; Kircher gives us KENESOÜ for a goose; but the ESOÜ means gregarious, probably in contradistinction to the Egyptian sheldrake, and the simple etymon approaches to the name of a goose in many other languages. We have, therefore, literally BIRENICE; or, if the N must be inserted, the accusative BIRENI-

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CEN, which may easily have been confounded by the Egyptians with the nominative. The final characters are merely the feminine termination. The enchorial text affords us a remarkable instance of the diversity which was allowed in the mode of representing the same name. The first character has not the least resemblance to the basket; but the first and second together are very commonly used in the manuscripts, as a coarse representation of a boat, which was called BARI, or possibly BERE, for it is doubtful whether Kircher had any other authority than that of Diodorus for BARI; and the word BEREZOUTS is used for another vehicle. The enchorial N may possibly have been derived from a horizontal line, turned up at one end; we have then the three dashes for the I, and the two angles seem to have answered to the KE, for a bird is not uncommonly scribbled in some such manner; so that we have either BARINICE or BERENICE, by a combination somewhat different from the former.

59 . . 65. The temple at Ombos was dedicated, as we find from the Greek inscription copied by Mr Hamilton, " in the name of the divine Ptolemy Philometor and Cleopatra, and their children, to Arueris Apollo, and the other gods of the temple, by the infantry and cavalry of the nome." We may, therefore, expect to find in it the names of these sovereigns, together with those of some or all of the earlier Ptolemies; and, accordingly, we are able to determine, without difficulty, some epithets which seem to be characteristic of this and the two preceding reigns; but, hitherto, nothing has been observed that can be considered as so clearly denoting either Philadelphus and his queen Arsinoe, or Euergetes and his Berenice, although some assistance might have been derived, in identifying them, from the enchorial text of Rosetta. We have, however, in the same temple, a name, evidently compound, in which a basilisc is followed by two feathers and a bent line; and to judge from a comparison of the enchorial text with the manuscripts, a basilisc ought to be the emblem of EUERGETES; the part of the name preceding it is, however, not Berenice, and must, therefore, in all probability, be ARSINOE, the daughter of Euergetes. But it seems impossible to attempt to compare the characters employed with the sounds; since they sometimes occur in an inverted order, which the sounds could not do. Indeed, the name seems to be very often repeated in situations where its most essential parts seem to be a quadrant of a circle, two feathers, and a bent or broken line; in other places, as at Dendera, the bird, the hand, and the oval, are added; and it is not impossible that the quadrant may have been meant as a representation of a lentil, which in Coptic is ARSHIN, and which alone may have been sufficient to identify the name. It occurs in the celebrated zodiac at Dendera, and very frequently at Philae, and it may possibly, hereafter, lead us very readily to discover the hieroglyphical name of *Philadelphus*. That of PHILOPATOR is satisfactorily ascertained by the assistance of the character employed for " father" in the Rosetta stone, though that character is much mutilated, and could not have been positively determined without this coincidence. The name is found in the *great* temple at Edfou still more distinctly than at Ombos, and it occurs several times at Karnak. EPIPHANES is never distinguished in any other inscription by the characters appropriated to him in that of Rosetta (N. 121); but we continually find a synonymous emblem, which is employed in the Rosetta stone to signify " enlightening," where the Greek translation has EPIPHANES; and this character, placed between two hatchets facing each other, can only have meant the " illustrious deity," or deities. In this form, the name occurs very frequently at Philae, and in the great temple at Edfou, where it seems to be the latest name. For the PHILOMETORES, we have a character which occurs in some other monuments, and means apparently " mother," the name containing it being found several times in the temple at Ombos. At Kous, or Apollinopolis Parva, there is another Greek inscription of the Philometores and their children; but in the hieroglyphics copied by Denon, the names of the sovereigns seem to be wanting, and that of a young prince only remains, a colossal statue of whom is figured by Montfaucon in his *Supplement*, having the same name in the belt, with the addition of " the son of King Ptolemy;" it will, therefore, be justifiable to distinguish this personage by calling him *Cleopatrides*. The divine honours, which are so often attributed in these inscriptions to the reigning sovereigns, afford us an explanation of the Greek inscriptions to the " Synthronous gods of Egypt," which repeatedly occur; and of the description " Fraternal gods," as, indeed, Philadelphus and his queen are called in the Greek inscription of Rosetta.

C. PRIVATE PERSONS.

66 . . 71. We find the names of six individuals expressed in the enchorial text of the inscription of Rosetta, though they are wanting in the distinct hieroglyphics; but, as they are clearly ascertained by the context, they are of considerable value in tracing the approach of the hieroglyphic to alphabetic writing. These are AËTUS, PHILINUS, DIOGENES, PYRRHA, AREIA, and IRENE. In Diogenes and Areia, we discover no traces of the ring which is the usual characteristic of proper names; and on the other hand, we find occasionally, in some of the manuscripts, the parts of the ring applied to a title of Osiris, which is more regularly written without any such distinction.

72. A name of a private individual is inserted from a sarcophagus in the British Museum, engraved by Alexander, in his *Egyptian Monuments*. Its form is not that of a parallelepiped, but more accommodated to the shape of the body. The pseudonymous appellation *Ramuneus* has been derived from the elementary characters already observed in the names of RE and AMUN.

D. ANIMALS.

73. A figure sitting on the ground, and stretching out one hand, seems to imply simply a MAN or person; which is certainly the sense of the enchorial

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character that commonly answers to it in the manuscripts; but in composition the figure often appears to lose this sense.

74. The horned snake, creeping along, is clearly meant, in some parts of the inscription of Rosetta, for HIM or IT; although it has other senses in composition. It is very remarkable, that the enchorial character, and that of the manuscripts, resembling a *y*, approaches extremely near to the Coptic F, which also means "him;" and HOF, or HFO, is the Coptic term for a snake; so that this coincidence seems to afford us another trace of the origin of the alphabet.

75 . . 78. The BULLOCK, the RAM, the ANTELOPE, and the TORTOISE, are proved to be sometimes representations of the things which they resemble, by their occurrence in inscriptions accompanied by tablets; though some of them have probably, elsewhere, a metaphorical sense. The ram is often represented with two pairs of horns; the one natural, the other imaginary.

78*. The CROCODILE is identified by a very distinct drawing in a manuscript sent home by Mr Bankes, and is repeatedly designated in the text by a figure representing it. (a) The deity with a crocodile's head is a separate personage, and is denoted by a figure of the same animal with the tail turned under it. (b) Plate LXXVIII. (L)

79. The asp or BASILISC is so coarsely represented in the stone of Rosetta, that the object intended by it could not have been conjectured without a comparison with other inscriptions; the context was, however, sufficient to determine its meaning from the examination of this monument alone.

E. INANIMATE OBJECTS.

80. The essential parts of the name of EGYPT seem to be the square and the wheel, signifying "splendid land." In addition to these, or their rudiments, the enchorial word has at the beginning a character which generally answers to an arm holding a feather, or to the flame of a lamp, an emblem which seems also to relate to Egypt in one of the lines of the inscription of Rosetta. A flame and a heart are mentioned by Horapollo and by Plutarch, as employed in the name of Egypt; but a word occurring so frequently is very likely to have been expressed in a variety of ways. The exact combination of characters generally used on the stone has not been observed in any other inscription.

81. The name of MEMPHIS cannot be determined without some uncertainty; the line of hieroglyphics, in which it is contained, being in several respects obscure.

82. The character, supposed to denote the Nile, as a deity, must also sometimes be understood as merely meaning a RIVER; and there is reason to think that the Nile itself was generally called by the Egyptians "the river" only. The enchorial character, used to denote both the Nile and a river, or canal, sufficiently resembles the hieroglyphic to favour this interpretation; and it is in some degree confirmed by the occurrence of the character alone on a water jar of Peiresc, delineated in Kircher's *Oedipus;* and, together with other characters, on the five vases found by Paul Lucas at Abousir. By accident, Kircher appears, in this single instance, to have been right in one of his conjectures; for he calls this character a Nilometer, and considers it as emblematic of the Nile.

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83. The word GREEK, in Coptic UININ or OUEININ, in Thebaic OUEEIENIN, supposed to have been derived from *Ionian*, seems to exhibit in its form something like an imitation of the sound. The curl on a stem is sometimes exchanged for the term *divine*, and appears to mean "glory," in Coptic OOU or OÜ, which is nearly the sound attributed by Akerblad to the enchorial character, a little like the Hebrew U; the feather, as in Ptolemy and Berenice, may be read I or EI, having the three dashes to express them, as usual, in the enchorial text; the serpent is ENEH, "ever;" and the hat, which looks a little like a plough, is equivalent to the waved line (N. 77), and must be read N; so that we have very accurately OUIENEHN, which seems to be near enough to OUEININ, to justify us in considering these characters as phonetic.

84. The ladder is well marked as meaning COUNTRY; it may perhaps be intended to represent a field with its divisions; but it is uncertain whether or no it is the same symbol that enters into one of the names of Arueris (N. 13), the sculptures of the Rosetta stone being by no means highly finished.

85. It is remarkable, that the wheel, signifying LAND, had been noticed by the Jesuits, as resembling the old Chinese character for the word *field;* but this is the only one, of a multitude of similar conjectures, that has been justified by more complete evidence. (*Phil. Trans.* 1769. Pl. 28.)

86. The star is shown to relate to a real STAR, by inscriptions accompanying the zodiacs. It has also elsewhere a figurative sense, meaning an attendant or *ministering spirit.*

87. The open square is found in both the combinations of characters, which are most commonly used for expressing a TEMPLE; the feather signifies ornament or consecration; the oblong figure, either the sacred inclosure or a sacred seat, the character for a god being sometimes placed within it. The feather is occasionally converted into an inclined oval, the square being at the same time a little altered; a difference which may be observed in other inscriptions, as well as in the Rosetta stone.

88. The character representing a SHRINE so much resembles the object which it denotes, that it was the most readily identified of all that are found on the stone of Rosetta. The character signifying a priest was the second; and the combination of both afforded a full confirmation of the truth of the explanation. The enchorial character for a shrine is derived from the sitting statue which always accompanies it.

89. The open square, occurring in HABITATION as well as in temple, must probably have meant *house* or building; or possibly stone only.

90. The THRONE, or chair of state, occurs in a great variety of tablets. It evidently bears its most natural signification in the character denoting sta-

tue, n. 102, and in some other instances; but it appears to bear, in some inscriptions, the metaphorical sense of a residence or habitation.

91. The COLUMN, or pillar, is too much like the object it denotes, to allow us to doubt respecting its meaning, considering the sense of that part of the inscription of Rosetta in which it occurs.

92. The characters denoting a DIADEM are sufficiently determined by the first inscription of the stone; and they so much resemble the corresponding passages of the enchorial text, that we can scarcely hesitate to admit the intimate connexion of the two modes of writing, without seeking for any further proofs.

93. The sacred ORNAMENTS are expressed by three feathers, fixed to a bar, which appears to be held by two arms. The remaining part of the character occurs very frequently as a sort of termination, and seems to answer to . . *ments.*

94. . 99. The boat or SHIP, the SPEAR, the BOW, the ARROW, the CENSER, and the BIER, are sufficiently identified, by the comparison of various tablets with their inscriptions. The ship occurs frequently as denoting the sacred boats, in which the representations of the deities are conveyed; though they are not always accompanied by water. But it has been observed, that the Egyptians attributed ships rather than chariots to the sun and moon, as gliding smoothly through the skies. The first part of the enchorial word, which has been supposed to be a B, is evidently identical with the character always found in the manuscripts written in the running hieroglyphics, as the first part of the delineation of a ship. It is remarkable, that, in the inscription at Esne, as copied by the French, the point of the arrow is turned towards the back of the bowman, instead of being directed towards the enemy.

100. The TEAR, in some of its representations, is very clearly expressive of the thing intended; and this resemblance, together with its frequent attendance on a corpse and a bier, is sufficient to explain its sense. It occurs also sometimes within a border, as a peculiar deity; but it seems to be much more commonly emblematical of Osiris, of Apis, or of Mneuis. It is not unfrequently found as a detached figure, in a kind of pottery, with a green glazing; and may perhaps have been worn, instead of a mourning ring, as a memorial of a departed friend. It has most commonly been called the *equi sectio*, and supposed to represent a horse's head, or the rostrum of a ship, while the ingenious Kircher has made it a *phallus oculatus.* Among the antiquities collected by Lord Mountnorris in Egypt, is an eye seen in front, and apparently shedding a tear.

101. The character for an IMAGE seems to mean *a wrought man;* the hands, connected with an eye, appear to be holding an oar, as an emblem of *labour.* The same character, with a slight variation in the form of the eye, means a rower, (n. 136.)

102. The sitting STATUE has no character to imply wrought; but it is followed by a bent line, which seems to be a term of respect, and may possibly answer to OSH, "great," The same bent line occurs on the great sarcophagus of green breccia, as a personification of one of the qualities of Osiris, probably his *magnificence.* It is often exchanged in the manuscripts for the divided staff; and both are represented in the running hand by a figure like a 9 or a 4. In the enchorial text this character seems sometimes to be expressed by a single line, either straight, or bent sideways into an angle, like part of a K. A similar "divine statue" is decreed to "King Nuncoreus, the son of Sesostris," on Mr Montagu's frize. Hierogl. 7 S l.

103. LETTERS are denoted by a character which seems to represent some of the materials employed in writing; and which is indeed not extremely unlike an inkstand figured in Caylus's Recueil, and consisting of two parallel tubes at some distance from each other, with a cover connected by a chain instead of a hinge. Besides the very well marked passage in the Rosetta stone, the character occurs in many manuscripts near the representation of a Thoth employed in writing; and the enchorial character, corresponding to it, is also found in the term *sacred scribes* at the beginning of the inscription.

104. In the numerical tablet of the great French work, believed to have been found at Karnak, a character may be observed which frequently precedes a numeral, and which resembles a weight with its handle. Hence we may conjecture, with considerable probability, that it represents some *weight* of unknown value.

105. The enchorial character for GOLD is perfectly well determined; and its resemblance to a little vase under a sort of arch is so strong, that we may safely attribute the same sense to this hieroglyphic, although it appears to be wanting in one or two passages of the sacred inscription of Rosetta, where it ought to be found. In the great ritual, we observe this character immediately preceding a shrine, as if a "golden shrine" were intended; and, in several other places, it is connected with a number, as if it meant *pieces of gold;* for instance, in the green sarcophagus, with the number 360. Sometimes, also, it appears to be used in a metaphorical sense, as a complimentary epithet of a monarch, or perhaps in allusion to his riches. Thus, on the black frize of Nuncoreus, we have, over the king's figure, the characters, "Joy, Life, Stability, Power, *Riches,* Like the Sun, for ever." Hier. 7 p.

106. Near to the character for gold, in the margin of the great ritual, is a sort of open box, supported on a flagstaff; and a similar box, with a semicircle under it, seems to mean SILVER; at least it considerably resembles the enchorial character for silver, which is perfectly well ascertained.

107. We find, in several inscriptions, representations of objects which are also observable in the tablets accompanying them, although it is difficult to say for what they are intended. Two of these are copied from the frize of Ficoroni and Montagu, Hier. 9 okl, RSKL, 7 LMQ. The former seems to be a sort of cloak, with a fringe at the bottom; the latter is a little like a pear; but this character does not occur so clearly in the inscription.

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F. ATTRIBUTES AND ACTIONS. (Plate LXXVI.)

108. The *crux ansata*, sometimes called the Key of the Nile, is usually employed as a symbol of divinity; but its correct meaning is LIFE, as Lacroze rightly conjectured, although his opinion respecting the origin of the character is inconsistent with the form of its oldest and most accurate delineations; and there is no one instance in which it is so represented as to stand in any relation to a sluice or a watercock. According to Socrates and Rufinus, the Egyptian priests declared to their Christian conquerors under Theodosius, who were going to destroy the Serapeum at Alexandria, that the cross, so often sculptured on their temples, was an emblem of the life to come. This passage has been understood by some authors as relating rather to the cross without a handle, which is observable in some rare instances, and indeed twice on the stone of Rosetta; but this symbol appears rather to denote a protecting power, than an immortal existence. It happens, perhaps altogether accidentally, that one of the contractions for the word *God*, which are commonly used in Coptic, approaches very near to this character, except that the arms of the cross are within the circle.

109. ETERNITY is represented simply by a serpent rising in an oblique arch, and without horns; the serpent devouring its tail, and making a ring, is never found as an Egyptian emblem. Horapollo says that eternity was denoted by a serpent having its tail hidden under its body; and that such serpents were called URAEI, meaning in Greek BASILISCS, which agrees very well with the sense of the Coptic URO, "king;" but this description answers better to the *asp* of the inscription of Rosetta, which has also some relation to the representations of the deities, though it does not exactly mean immortality.

110. The cross with the serpent is a very common epithet, in the sense of everliving, or IMMORTAL, AEONOBIUS: the waved line is in general a preposition, or a termination, meaning *of*, *to*, or *for*; and it appears to be synonymous with the hat (n. 177). Almost all authors have very hastily taken for granted, that this character must relate immediately to water, wherever it occurs, although we find it repeatedly in every line of the inscription of Rosetta, where water is not once mentioned. The fact, however, is, that its prototype seems to have been a stream of water or of any other liquid, flowing *from* a vessel, and poured *on* some other object; and that the idea of the liquid was completely dropped in the general employment of the character; while that of the *connexion* only was retained; and the hat or cap being also similarly forgotten, while its connexion with the head of the wearer only was suggested by its figure. In this compound character, we have two particles nearly alike, the semicircle and the line; for that they cannot be very different is shown by the occasional substitution of two semicircles for the combination. One of them seems to serve for the connexion between life and eternity, "life *for* ever;" and the other to make the new compound an adjective, "liv*ing* for ever."

111. The triangle or pyramid occurs very commonly among other emblems of prosperity and happiness; and it is found in the frize of Montagu and Ficoroni, in the decided sense of an offering or a present in general, while, in another place, it is made an offering in its own form; so that we can only interpret it as signifying JOY, or pleasure, or prosperity. (Hierogl. 7 Mqr, Uqr; 9 Re, Rl; 7 Uq, Urs.)

112. POWER appears to be indicated by a sceptre having the head of an animal, which is often placed in the hands of the deities, and often stands with the cross, the pyramid, and the altar, as an emblem of the blessings attendant on the favourites of the gods. It is seldom used in the text of inscriptions, but it occurs once in that of Rosetta.

113, 114. STABILITY is denoted, on the Rosetta stone, and elsewhere, by the altar, which seems to have been fixed in the ground as a column. When repeated, it makes the verb ESTABLISH; but it often occurs singly, and not uncommonly as an unconnected emblem, accompanied by other characters of similar import; and it is sometimes found as a detached figure, formed of glazed porcelain. The two altars are very conspicuous objects in some of the epistolographic manuscripts, and are very useful in comparing them with the hieratic; but the word employed in the enchorial inscription of Rosetta seems to be derived from a different origin.

115. A drop or club over a basin, followed by a bent line, seems to mean GREAT STRENGTH; though it is difficult to say what the character is meant to depict. In some other places, it seems somewhat to resemble a kind of head dress.

116. The bullock and the arm, which generally occur at the beginning of the inscriptions on the obeliscs, agree very well with the epithet MIGHTY in the translation of Hermapion. The arm is, in many other instances, used in compound characters.

117. VICTORY is denoted by a branch, perhaps a palm branch, with a semicircle and a circle, sometimes preceded by the waved line.

118. The character signifying FORTUNE somewhat resembles that which denotes "gold" (n. 105), but, instead of the arch, we have an angular line, which seems to be intended for a pair of arms grasping the vase. The whole assemblage approaches, also, a little to the form of a pocket, or purse, as it is frequently delineated.

119. The open square, bent inwards, clearly means SPLENDOUR or glory, though it is uncertain what object it is intended to represent. In some cases, a crescent seems to be substituted for it, as if it bore some relation to the sun, and the moon afforded a parallel sense.

120, 121. ILLUSTRIOUS is expressed, in the inscription of Rosetta, by the open square, for "splendour," the oval, which signifies addition, or respect, making it a kind of superlative, and the pair of legs, which very naturally convey the idea of BEARING, or possessing; so that the whole makes the epithet EPIPHANES. This assemblage is, in some of the manuscripts, very commonly followed by a bird, or its equivalent, a half arch, apparently serving as an intensitive.

122 . . 124. The feather, when alone, seems to

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imply HONOUR, as well as when accompanied by a man stretching out his arm, or by a bird. The bird, also, frequently stands alone in similar passages, and must be translated respect, or RESPECTABLE. The block with the bird has also manifestly the same sense in the great ritual, and the vase with the bowl is so nearly synonymous with it, that we can only translate it VENERABLE; and these characters are frequently exchanged for a sort of bench, with a dash under it, a symbol which may, however, possibly have been deduced from some different origin. The sense of the feather is peculiarly illustrated by its occurrence with a drop or club, a serpent, and a line, at the beginning of a great variety of inscriptions, apparently signifying *immortal honour to*. See n. 172.

125. The eye, either with or without the pupil, and either preceded or followed by the undulated line, has a sense somewhat similar to all these, and is often employed at the beginning of the honorary inscriptions. On the Rosetta stone, it means distinctly RITE, or adoration. The enchorial character, corresponding to it, expresses also simply *doing;* as in Greek the same word signifies to "do" and to "sacrifice."

126. WORSHIP, or the Greek THERAPIA, is denoted by a very unintelligible character, resembling a kind of capstan, which is frequently delineated in the boats of the tablets; if it is not intended for some emblematical figure erected in the boats. On the great green sarcophagus, the long bent line is a snake, and the point projecting upwards from the middle is a sword. But these resemblances afford us little or no assistance in tracing the connexion between the whole emblem and its sense.

127, 128. The character denoting FATHER is found in some of the inscriptions of the Ptolemies, in such circumstances that it might as easily be supposed to mean mother; but, by means of Mr Bullock's scarabæus, compared with some other monuments, another character having been determined for MOTHER, it became easy to identify the symbol for father on the Rosetta stone, where it had been a little injured, and imperfectly copied in the engravings.

129. The frequent occurrence of the Egyptian goose, or sheldrake, with a circle over it, between two proper names, sufficiently points out the meaning of these characters, which can only relate to the connexion between them, and which must naturally mean SON; the circle may perhaps be intended for an egg; but in the painted sculptures the disc is red, and the circumference light. The enchorial character nearly resembles the form in which some kinds of birds are usually expressed in the manuscripts (n. 22, 130). Mr Bailey has also observed the occurrence of the bird between two proper names, and has identified it with the CHENALOPEX mentioned by Horapollo, as employed to signify son, on account of its courage in defending its offspring. This quality might rather have been expected to lead to its adoption as a symbol for a parent; but its existence in the bird in question is confirmed by the observations of modern naturalists respecting the sheldrake, the *tadorne* of Buffon, which has generally been considered as the chenalopex, and resembles very accurately the best of the hieroglyphic delineations of the bird, although the colours, as exhibited in the *Description de l'Egypte*, are not correctly natural.

130. The same bird, with a leg or a dash instead of a circle, seems to mean a minister or ATTENDANT, especially in several parts of the inscriptions on the Lover's Fountain. There are also some other characters which seem to be nearly synonymous with these; one of them may possibly be meant for a *tail*, implying a follower, as SAT and SA are nearly alike in Coptic; another is sometimes worn as a collar, perhaps implying subjection, and meaning servant.

131, 132. Instead of the usual character for son, we sometimes find, between two names, a serpent with a globe substituted for the bird, and an oval for the circle; and the context seems to require that the meaning of these symbols should be a DAUGHTER, but probably with some particular character of royalty or divinity; and at Philæ we find a dual, meaning SONS or descendants, as a son and a daughter, expressed apparently by two circles only.

133. A CHILD, or *infant*, is represented by a figure bent as if sitting, and putting his finger on his lip. This is sufficiently established by the triple inscription; but it is still further confirmed by a plate of the *Description de l'Egypte* (Antiq. II. pl. 86, f. 1); in which a figure of this kind is represented as immediately derived from the father, who seems to be inspired by a beetle entering his mouth. The manuscripts afford us here some valuable steps, by which the enchorial character is connected with the distinct hieroglyphics. Another figure, which is elsewhere used as corresponding to a beetle, is also found in the enchorial text in the sense of son or offspring.

134, 135. A circle, with an arm holding an angular line, means a DIRECTOR; the angular line is intended for part of a rudder; and the same character, with the addition of the figure of a boat, denotes the pilot or HELMSMAN, as is obvious from many parts of the green sarcophagus. The circle and arm are also found in the character denoting *dedicate*. (N. 150.)

136. A pair of arms holding an oar, and connected by a sort of sector, signifies a ROWER; and possibly also a labourer, or workman in general, as in *image*. (N. 101.)

137. A stem of a plant, perhaps a reed, followed by an insect like a wasp or ichneumon, but probably intended for a bee, and by two semicircles, is the complete emblem for a KING; but the reed is often used alone in the same sense, and the insect sometimes occurs without the reed. Plutarch says, that a king was denoted by a leaf, THRION; and Horapollo tells us, that a bee signified a people obedient to a king; hence this symbol might be interpreted *king of men*. Ammianus Marcellinus, however, asserts, more simply, that a king was denoted by a bee. It appears from the manuscripts, that the beginning of the enchorial character, which Mr Akerblad reads PHU, is derived from the elementary traces representing the reed, the semicircle, a waved line, and a sitting deity, meaning *the divine king*, an assemblage which often occurs on the green sarcophagus, and elsewhere, as applied to a royal person. The remainder of the enchorial character seems to repre-

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sent a termination consisting of a semicircle and a vessel, which is often added to a name, apparently as a demonstration of respect, like the vessel and the spiral in the case of the god Nilus. (N. 19.)

138. CONDITION, or subjection, is denoted by a character which somewhat resembles an altar with an offering of flowers; but which might also be intended for the cup of a flower, with an insect hovering over it.

139. In the term KINGDOM, the crown is figuratively employed for its wearer; a metaphor common in many modern languages.

140. The character denoting a LIBATION is very indistinctly traced in the sacred inscription of Rosetta, so that it would have been impossible to explain its original form without the assistance of other hieroglyphical monuments. The long water jar, out of which the kneeling figure is pouring a divided stream, somewhat resembles those which a modern Egyptian woman is seen carrying, in a plate of Mr Legh's second edition.

141, 142. The vase with the stream, which frequently occurs in the character for PRIEST, is sometimes found alone, and must therefore probably relate to some particular CEREMONY performed by the priests, approaching to the nature of a libation. On the stone of Rosetta, the line is a simple curve, not waved; nor is the vase more distinctly represented. Instead of the sitting figure, a foot is sometimes substituted, as in the word *attendant* (n. 130): and the enchorial character is a more tolerable approximation to this form than to the complete figure.

143. PRIESTHOOD is simply the *condition* of a *priest;* the character prefixed answering to the Coptic prefix MET, and to the Greek termination EIA.

144. The ornaments of the head are very generally used as indicating the person by whom they are worn; and flowers, probably those of the lotus, are frequently found on the heads of the priests, as well as in the inscriptions which accompany them. In the inscription of Rosetta, the sense SACERDOTAL agrees very well with the context, where this character occurs; though it cannot be deduced with absolute certainty from the comparison with the Greek.

145. It is by no means easy to explain why the figure like a buckle should clearly mean an ASSEMBLY: perhaps, however, the upper part may originally have been a crescent, implying monthly; and the scale or basin below is occasionally found supporting some offerings, which are set upright in it; so that the whole may have meant *a monthly exhibition.*

146. The character *god* is made an adjective by the addition of the waved line, and of the long drop, which seem simply to convert it into the term SACRED; or, if the drop has any other meaning, it can only relate to worshipping or honouring; as the character prefixed in the enchorial text, which is equivalent to the scale or basin, is elsewhere employed to signify *honour* or *attention.* In some other instances, a circle and a waved line seem to be employed in a similar manner, for connecting one character with another like substantive and adjective.

147. An epithet implying CONSECRATED, or dedicated, is composed of a trident, or triple branch or root, followed by a bent line. It occurs very commonly near the beginning of inscriptions, on obeliscs, and elsewhere.

148. A little oblique cross, over an arm with a feather, seems to mean to GIVE, and perhaps to fight and to defend; as, in Coptic, the word TI has both these senses. It is often preceded by a circle and a semicircle.

149. The hand bearing the triangle or pyramid (n. 111) manifestly means, in the frize of Montagu and Ficoroni, to OFFER, as an oblation to a deity.

150. In the inscription of Rosetta, we find the word DEDICATE expressed by a bent line and a sitting figure, with the circle and the arm holding the rudder, n. 134; the character already interpreted *consecrated* precedes, but it is not absolutely certain that it belongs to the same phrase.

151. The term LAWFUL is naturally enough derived from a deity in his judicial capacity; the figure is preceded by a bird, placed between two semicircles, which must here mean *according to*, answering to the termination *ful.* Sometimes a curved line, supported by a stem, is substituted as a synonym for the figure of the judge.

152..154. The character representing GOOD strongly resembles the figure of a lute, depicted in the chamber of the harps, among the catacombs, and may have alluded to the pleasing sound of music. The plural, with the scale or basin, which implies BESTOWING, makes the epithet EUCHARISTUS, which in Greek is somewhat ambiguous, meaning either grateful or MUNIFICENT; the latter, however, must be its sense in this inscription, because *good gifts* or *delights* may be plural, but *gratitude* not so easily. The lute is also found denoting good in other parts of the inscription. The enchorial character for the scale could scarcely have been suspected to be derived from it, without the assistance of the manuscripts, which constantly exhibit an intermediate form, intended, perhaps, to comprehend one of the lines supporting the scale.

155. The semicircle, with two oblique dashes, seems to mean GREAT in the name of Thoth, who is called, in the Greek inscription of Rosetta, Hermes the *great and great:* while, in other places, this character seems almost always to convey the sense of a dual. The enchorial epithet of Thoth is a little like the crown with two semicircles, which is most frequently found among the titles of Osiris, especially when he sits in judgment.

155*. The two kinds of hats, worn by the different deities, seem to be intended by the characters of the Rosetta stone, which express the UPPER and LOWER regions or countries. These two characters are also found together in the green sarcophagus as the names of two goddesses; and they occur together in one or two passages of some of the manuscripts, and in an inscription at Philae, so that, although the representation is very indistinct in the particular case of the Rosetta stone, there is little doubt that the cap of Osiris meant, in this case, *superior,* and that of Hyperion and other personages *inferior.* (Pl LXXVIII. L.)

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156. A circle and a semicircle stand, in several passages of the inscription of Rosetta, for OTHERS, or remaining.

157. Possibly, the bowl and the bird together mean *say* or *call*, and the figure of a man may serve to make the passive CALLED.

158. The second bowl, substituted for the bird, does not appear very essentially to alter the sense, which is still a thing *said* or proclaimed; a DECLARATION, or a decree.

159. The characters denoting MANIFEST seem to have some analogy to *called*, though their derivation is obscure. The first character may either be intended for the country (n. 84), or for a kind of flag or banner.

160. The ring, which implies a NAME, and which, elsewhere, distinguishes proper names, seems to be an imitation of the label, called a "phylactery" in the Greek inscription of Rosetta, on which the name of a figure was usually distinguished.

161. A disc, with rays descending from it, is one of the few characters in which the form gives us some assistance towards determining the sense, which is found to be ENLIGHTENING; though the Egyptians do not seem to have been very correct in their delineation of the motion of light, which they make to diverge in curved lines, like those described by a common projectile. See n. 8, n. 63.

162. The square block, the semicircle, and the chain, are employed very clearly in the sense of LOVING or beloved; the Coptic MAI. In the enchorial character the square and semicircle seem to be sometimes transposed, and sometimes changed into an oval.

163. PRESERVER, or saviour, is represented by a sort of trefoil, with a long stem, which answers to a cross or obelisc in the enchorial text; but, in other passages, the character takes the form of a still simpler club: and, in others again, it has something like a bulbous root.

164, 165. (Pl. LXXVII.) A frame like a ladder, supported by a stem, occurs sometimes as a part of a head dress, but it is difficult to say if it represents any other object. Followed by an arm, and a pair of legs, it signifies SET UP, and this combination of characters is of very frequent occurrence; sometimes also the bent line or divided shaft forms a part of it. In Coptic, *set up* is expressed by *set on foot*, which seems to retain the analogy of the hieroglyphical character. The substitution of a pair of feathers for the legs, however, does not appear materially to alter the sense; the context, where it occurs, requiring the word PREPARE or construct.

G. RELATIONS.

166. Two ovals, with a semicircle and an arm, very clearly signify IN ORDER THAT. The ovals seem to mean to or *for*, and the arm action or *doing;* as our own *that* seems to be allied to the German *that*, which means *deed*. The same combination of characters appears to denote, in another passage, *to add to;* and one of the ovals is sometimes omitted. The Coptic may be either HINA or ETHBE.

167. The symbols, employed in the sense WHEREEVER, seem to mean separately, *at*, *in*, *one*, or *in*, *place*, *one;* and, transposing the two last, we may make a very good Coptic word E-U-MA.

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168, 169. The arm and chain signify AND or ALSO; and the oval sometimes takes place of the arm, without much variation of the sense; this combination is also found in the sense of *with*, or *together with*. The elementary ideas seem to be *put*, *with*, or *add*, *with*. Between the names of Ptolemy and Berenice at Karnak, the arm and chain are separate.

170. The half arch, or the fork, which is perfectly equivalent to it, followed by two curls and two semicircles, mean MOREOVER: the reduplication probably resembling that of many of the Coptic verbs, which generally imply a continued action.

171. The combination of the loop or sling, with two semicircles and three ovals, means very clearly LIKEWISE. The loop seems to represent a bucket, intended for one of a pair, to be carried on a pole, as they are frequently delineated in the tablets: so that it must mean a *companion;* and accordingly we find it in a very common epithet of a king, on obeliscs and elsewhere, with a circle and a bar, denoting *the companion of the sun*, or simply *resembling the sun*. In the enchorial character for *likewise*, the symbols seem to be transposed, and the loop is doubled.

172. An owl, signifying IN, seems to be nearly synonymous with the half arch, which is also sometimes to be understood in the sense of *all:* both these characters occur also in many instances where they can only be considered as marks of respect, and not very essential to the sense; and in this they resemble the Coptic prefix M, which is a particle not very distinctly intelligible, nor capable of being translated; it is also not a little remarkable, that the M of Akerblad's alphabet is the enchorial character which answers to both of these symbols. (See n. 123.)

173, 174. A hare over two waved lines is employed, either alone, or together with a head, dash, circle, and dash, which have separately a similar sense, for UPON, OVER, or *at;* and it is remarkable, that a similar relation exists in Coptic between EHREÏ, and EJO; JO or DCHO also meaning a head. The enchorial character, in some of it forms, is manifestly a coarse imitation of an animal. The head is always represented in the manuscripts, by a character nearly like a Greek Σ; and this may possibly have been the origin of the Coptic letter JANJIA, if it was derived from a hieroglyphic; but it is equally probable that it may have been intended for a combination of a *delta* and a *chi*.

175. A semicircle and an oval mean FOR, as relating to time.

176. A ball, with two short appendages, one narrower than the other, occurs several times on the Rosetta stone, and seems to have been intended for a head seen in profile, which is often found on other monuments. This character, together with a dash, seems to signify BY THE, or *each;* for instance *every* year, or *every* month.

177. The hat, interposed between "an image" and "the king," can only mean OF or FOR; it is often

substituted, in passages which are frequently repeated, for the waved line; each being probably equivalent to the Coptic NTE, or rather N; which also sometimes makes an adjective of a substantive, as NNUB, golden, from NUB, gold. See n. 58, 83, 140.

H. TIME.

178. A DAY seems to be very naturally expressed by *splendour* of the *sun*, or sunshine. See n. 119, n. 8.

179. A crescent turned downwards, with a star and the sun, makes up the character signifying a MONTH; to which a semicircle and a scale or basin are sometimes added. Horapollo says, that a month is denoted by a palm branch, or by an inverted crescent; but the crescent is too indistinct, on the stone of Rosetta, to have allowed us to recognise it, without the assistance of the collateral inscriptions.

180. A YEAR is denoted by a bent line with a little projection from the middle, which seems to represent a plant with an annual shoot or bud; it is commonly followed by a semicircle and a block or dash.

181. There is some little uncertainty respecting the exact limits of the characters denoting the first month THOYTH. The name seems to have some relation to gathering the harvest, and the emblem is probably intended for a field of corn: and perhaps, as the year is said to have begun originally with the dogdays, the appropriation of this character to the first month may have been contemporaneous with the origin of the calendar.

182, 183. The sixth month, MECHIR, is remarkable for having half as many crescents as the twelfth MESORE: this relation would without doubt be further illustrated, if we could discover any thing like a calendar, among the immense mass of Egyptian literature which is still in existence. The manuscript, which Montfaucon calls a calendar, merely because it is divided into twelve columns, has no pretensions to the name.

184, 185. The symbol for the sun seems to be employed in the designation both of the FIRST DAY of the month, the NEOMENIA of the Greek inscription, and of the last, or THIRTIETH DAY. Of the characters following the sun, the one seems to mean good, or rather *new*, as in Thoyth, the month of the new year: the other *old* or *last*. This character might be taken for a serpent, or for a branch of a tree; but it seems more probable that it is intended for the *tail* of an animal, since it occurs in several passages of the manuscripts as representing a tail; and the tail of the month is sufficiently expressive of the sense. See n. 130.

I. NUMBERS.

186. UNITS are denoted by short lines, like the Roman I. Mr Akerblad first noticed the first three numerals in the last line of the sacred characters of Rosetta, where the Greek text is deficient, and the words "first and second" only remain; and this observation alone was sufficient to prove, that the hieroglyphical characters related to a real language, and were not simply ornamental decorations, as some persons have imagined.

187. . 196. The twisted line, distinguishing the ORDINAL NUMBERS, answers to the Coptic MAH; which is prefixed to the cardinals in the same sense; in the enchorial text the corresponding character follows the number. The THREE points are more commonly employed, when they follow a word, to make it plural; but when they signify a numeral, they are generally placed immediately above some other character; and, in the enchorial inscription, this numeral is distinguished by making the lines oblique and joining them.

197. For the number TEN we have a Greek *pi*, either square or rounded, not only in the inscription of Rosetta, but in many other places.

198. We find the number SEVENTEEN recurring twice as a date in the inscription of Rosetta; the Greek text, in another part, alluding to the same period, has 18; and the enchorial words are too indistinctly marked to allow us to judge of the identity or diversity of the two numbers; but the difference of a day is of no consequence, since the festival of the "assumption of the kingdom" may easily have begun on the 17th of Mechir, and have continued to the next day, which is the date of the decree.

199, 200. The enchorial character for THIRTY, applied to years, seems to be the same as is elsewhere used in the sense of the *thirtieth day;* but the numbers are almost always confused in the running hand, and exhibit several deviations from the regular system of the sacred characters; the number FORTY, for example, in the remarkable passage relating to the 42 assessors of Osiris, seems to be denoted by a single line with a dash on it.

201. . 203. The curl, like the figure 9, meaning A HUNDRED, and the notched circle, supported by a cross, denoting A THOUSAND, occur, in several inscriptions, so combined with units and tens, as to leave no doubt respecting the numbers that they represent. This is particularly evident from the consideration of an inscription "believed to have been found at Karnak." (*Déscr. de l'Egypte. Ant.* III. Pl. 38. F. 26. . 30.)

204. PLURALS are distinguished by writing a character three times, or by putting three dashes after it; and sometimes, perhaps, though very rarely, before it: occasionally also by repeating a part of a collection of symbols once only. In the manuscripts, the three dashes are generally joined into a crooked stroke; which, in the enchorial inscription, sometimes both precedes and follows the word; while, in other cases, the second stroke is converted into a single vertical line, which serves to limit the extent of the characters meant to be made plural; the representation being so imperfect, that this assistance is more required than in the sacred characters: and it may be observed, that this second mark is never wanting in the enchorial inscription, as it must frequently have been, if the character had been alphabetical; since many of the Egyptian plurals end precisely as their singulars do; and even when they differ from them, it is not by the addition of any one uniform termination.

K. SOUNDS.

205. . 218. The *phonetic characters*, according to the traces which may be discovered in the words Berenice, Ptolemy, Greek, and some others (n. 56, 58, 74, 83, 123, 172), will afford something like a hieroglyphic alphabet, which, however, is merely collected as a specimen of the mode of expressing sounds in some particular cases, and not as having been universally employed where sounds were required. The *supposed enchorial alphabet*, which is subjoined, is applicable to most of the proper names in the inscription of Rosetta, and probably also to some other symbols which have been the prototypes of the characters: it is taken from the alphabet of Akerblad, but considerably modified by the conjectures which have been published in the *Museum Criticum.*

L. ADDITIONS. Pl. LXXVIII. See n. 21, 78, 155.

M. SPECIMENS OF PHRASES.

The last line of the inscription of Rosetta will serve as a specimen of the way in which the hieroglyphical characters were combined, so as to form a language; and will show at the same time the relation between the sacred and the enchorial texts. At the beginning of the line we find some obscurity, and a want of perfect correspondence in the two inscriptions; but it is clear that the fork or ladder, the arm and the feathers, mean to *prepare* or procure (n. 165); then follows *a column* (n. 91); the wavy line, *of* (n. 177); the semicircle and two dashes, with the arm, probably *strong* or hard; the block or square below, with its semicircle, *stone*; the loop or knot *wrought* or engraven; the half arch *in* or with; the instrument or case, *writing*, or letters (n. 103); the wavy line, the hatchet, and drop, with the three dashes making a plural, *appropriate to the gods*, that is, sacred (n. 146); the case again, *letters;* the hat, *of* (n. 177); the ladder, arm, and feathers, *the country;* the serpent and bent line, approaching to the sense of perpetuity and greatness, seem to be a mark of respect to the country, though it is barely possible that they may be substituted for the repetition of the instrument or case, and may mean the language, and belong to the following curl on the stem, the feathers, the serpent, and the hat, which signify *Greek* (n. 83). The headdress of flowers meaning probably a priest, the following curl with the dashes probably ornamental or honorary, or perhaps collective, and the two bowls, with the man in the plural, a publication (n. 158), the whole of these symbols must express *the honorary decree of the priests, or the decree of the assembled priests;* but the enchorial text seems to include the symbol for honour. The oval, with the semicircle and arm, implies in order that, or *in order to;* the fork with cross bars, the arm, the legs, and the snake, *set it up* (n. 164); the bird, *in* (n. 172); the three broad feathers over as many open squares, *the temples*, as a plural; the half arch and oval with the plural dashes, all, or *of all kinds;* the open square, wheel, scale, head, dash, and ring, Egypt (n. 80); the figure with a vase on his head, subjection or power, as in n. 139; making the whole, belonging to Egypt, or *throughout Egypt;* the fork and dash are in, or *in all;* the knots or chains, followed by the numbers, *of the first, the second, and the third order* (n. 187, 189, 191); the oval, half arch, and dash, *wherever*, or in which, leaving out "shall be;" the tool and standing figure, with the intervening characters, *the image* (n. 101); the hat, *of;* the reed and bee, with the semicircles, *King;* the square, semicircle, lion, half arch, two feathers, and bent line, *Ptolemy* (n. 56); the handled cross and serpent with the two semicircles, *the everliving* (n. 110); the square block, semicircle, and chain, *dear to* (n. 162); the hieralpha and two feathers, *Phthah*, or Vulcan (n. 6); all this being included within the ring or phylactery together with the name; the open square, the oval, and the pair of legs after the ring, *illustrious* or Epiphanes (n. 121); and lastly, the scale and the three lutes, *munificent* (n. 154); the conjunctions being often omitted, as they also very commonly are in Coptic, and even in Greek.

The enchorial text agrees in many parts extremely well with the hieroglyphics, according to the general style of imitation which has been already explained and exemplified, although in some passages there is a greater difference than might have been expected. The beginning of the enchorial line seems to contain the word decree, which cannot be found in this part of the hieroglyphics; the character for letters occurs three times in it, as if the sacred character used in the third place meant language; the "sacerdotal decree" of the sacred characters is omitted in the corresponding part of the enchorial; the world temples is repeated before each numeral; the term wherever is amplified; the image is a very coarse imitation, and is followed by the character for a deity, meaning sacred or divine; and, lastly, the name of Ptolemy is omitted, the word king being only followed by "whose life shall be for ever;" or a phrase of similar import.

N. COMPARISON OF MANUSCRIPTS.

The subjoined specimens of a comparison of the different manuscripts, which deviate more or less from the form of distinct hieroglyphics, with others in which those characters are preserved almost entire, though slightly traced, will serve to show the complete identity of the different systems in their original form; the first and fourth lines being taken from the great hieratic manuscript of Strasburg, and the rest from other copies of the same text, which are universally considered as written in the epistolographic character. We cannot discover the entire connected sense of the whole passages, but we may easily observe the symbols for *gods, established, Osiris, Isis, Nephthe,* "*Hieracion,*" *to set up, four, priests*, and *child* or *prince.* (*Déscr. de l'Eg. Ant.* II. Plate LXXIV. col. 106; LX. col. 3; LXII. col. 2; Plate LXXII. col. 38; LXVII. col. 2.)

SECTION VIII.—*General Character and Subjects of the Egyptian Monuments.*

By means of the knowledge of the hieroglyphic characters, which has been already obtained, we are fully competent to form a general idea of the nature of the inscriptions on the principal Egyptian monuments that are extant. Numerous as they are, there is scarcely one of them which we are not able to refer to the class either of sepulchral or of votive inscriptions; astronomical and chronological there seem to be none, since the numerical characters, which have been perfectly ascertained, have not yet been found to occur in such a form as they necessarily must have assumed in the records of this description: of a historical nature, we can only find the triumphal, which are often sufficiently distinguishable, but they may also always be referred to the votive; since whoever related his own exploits thought it wisest to attribute the glory of them to some deity, and whoever recorded those of another, was generally disposed to intermix divine honours with his panegyric. It has, indeed, been asserted, that the Egyptians were not in the habit of deifying any mortal persons; but the inscription of Rosetta is by no means the only one in which the sovereigns of Egypt are inserted in the number of its deities; the custom is observable in monuments of a much earlier age; indeed, in such a country it might be considered as a kind of dilemma of degradation, whether it was most ridiculous to be made a divinity, or to be excluded from so plebeian an assemblage; but flattery is more prone to err by commission than by omission, and, consequently, we find the terms king and god very generally inseparable. The sepulchral inscriptions, from the attention that was paid in Egypt to the obsequies of the dead, appear, on the whole, to constitute the most considerable part of the Egyptian literature which remains, and they afford us, upon a comparative examination, some very remarkable peculiarities. The general tenor of all these inscriptions appears to be, as might be expected from the testimony of Herodotus, the identification of the deceased with the God Osiris, and probably, if a female, with Isis; and the subject of the most usual representations seems to be the reception of this new personage by the principal deities, to whom he now stands in a relation expressed in the respective inscriptions; the honour of an apotheosis, reserved by the ancient Romans for emperors, and by the modern for saints, having been apparently extended by the old Egyptians to private individuals of all descriptions. It required an extensive comparison of these inscriptions to recognise their precise nature, since they seldom contain a name surrounded by a ring in its usual form: sometimes, however, as on the green sarcophagus of the British Museum, a distinct name is very often repeated, and preceded by that of Osiris; while, in most other instances, there is a certain combination of characters, bearing evident relation to the personage delineated, which occurs, after the symbols of Osiris, instead of the name; so that either the ring was simply omitted on this occasion, or a new, and perhaps a mysterious name was employed, consisting frequently of the appellations of several distinct deities, and probably analogous to the real name. That the characteristic phrase, so repeated, must have had some relation to the deceased, is proved by its scarcely ever being alike, in any two monuments that have been compared, while almost every other part of the manuscripts and inscriptions are the same in many different instances, and some of them in almost all; and this same phrase may be observed in Lord Mountnorris's and Mr Bankes's manuscripts, placed over the head of the person who is brought up between the two goddesses, to make his appearance before the true Osiris, in his own person, and in his judicial capacity, with his counsellors about him, and the balance of justice before him. (Hierogl. 5. E F G e f.) In this instance the phrase consists of the names of "Hyperion" and the Sun, preceded by a block and an arm with an offering (Plate LXXVIII. O), and it may be interpreted, without any violence, "the votary of Hyperion and of Phre." In a small manuscript, engraved by Denon, the part, which resembles the characteristic phrase of other manuscripts, is followed by the name of a king (P), which is nearly identical with that of the father of the Pseudomemnon in the British Museum (Q), the one having the hieralpha laid flat, the other the traces of the pedestal, which is equivalent to it. (N. 6.)

The tablet of the last judgment, which is so well illustrated by the testimony of Diodorus concerning the funerals of the Egyptians (Sect. 5.) is found near the end of almost all the manuscripts upon papyrus, that are so frequently discovered in the coffins of the mummies, and among others in Lord Mountnorris's hieratic manuscript, printed in the Collection of the Egyptian Society. The great deity sits on the left, holding the hook and the whip or fan; his name and titles are generally placed over him; but this part of the present manuscript is a little injured. Before him is a kind of mace, supporting something like the skin of a leopard; then a female Cerberus, and on a shelf over her head, the tetrad of termini, which have been already distinguished by the names "Tetrarcha," Anubis, Macedo, and "Hieracion," each having had his appropriate denomination written over his head. Behind the Cerberis stands Thoth, with his style and tablet, having just begun to write. Over his head, in two columns, we find his name and titles, including his designation as a scribe. The balance follows, with a little baboon as a kind of genius, sitting on it. Under the beam stand "Cteristes" and "Hyperion," who are employed in adjusting the equipoise; but their names in this manuscript are omitted. The five columns over the balance are only remarkable as containing, in this instance, the characteristic phrase, or the name of the deceased, intermixed with other characters. Beyond the balance stands a female, holding the sceptre of Isis, who seems to be called Rhea, the wife of the sun. She is looking back at the personage who holds up his hand as a mark of respect, and who is identified as the deceased by the name simply placed over him, without any exordium. He is followed by a second goddess, who is also holding up her hands, in token of respect; and whose name

looks like a personification of honour or glory, unless it is simply intended to signify "a divine priestess" belonging to the order of the Pterophori mentioned on the Rosetta stone. The forty two assessors are wanting in this tablet; and, in many other manuscripts, their number is curtailed, to make room for other subjects; but, in several of those which are engraved in the *Déscription de l'Egypte*, they are all represented, sometimes as sitting figures, and sometimes standing as termini, with their feet united.

The principal part of the text of all these manuscripts appears to consist of a collection of hymns, or rather homages to certain deities, generally expressed in the name of the deceased, with his title of Osiris, although the true Osiris is not excluded from the groups that are introduced. The upper part of each manuscript is occupied by a series of pictural tablets; under them are vertical columns of distinct hieroglyphics, or, in the epistolographic manuscripts, pages of the text, which are commonly divided into paragraphs, with a tablet at the head of each, the first words being constantly written with red ink, made of a kind of ochre, as the black is of a carbonaceous substance. The beginning of the manuscript is seldom entire, being always at the outside of the roll; as the "umbilicus" of the Romans was synonymous with the end. Not far from the beginning, we always find a large tablet, occupying the whole depth of the paper, representing the sun adored by his ministering spirits. In the large hieratic manuscript, which occupies four plates of the *Déscription de l'Egypte*, and which may be considered as a fine specimen of the most highly finished copies, there are at present only four columns remaining before this tablet. It is followed by a short section, with a rubric, which is not very distinctly expressed; after this are 35 others, beginning with a long rubric (Plate LXXVIII. R.), which is usually followed by the name of a divinity, represented in a neighbouring part of the margin, and which may be supposed to mean something like "Respect and reverence be paid to each of the sacred powers." The next ten sections begin with the rubric of a feather, and a sitting figure raising his hand to his head, as if holding a vase on it (S), meaning probably "Honour is due," or belonging to; then follow the name and titles of Thoth or Hermes, and the phrase describing the deceased in the character of Osiris; and afterwards, the names of each of a group of deities, which is represented in the corresponding tablet with an altar and a suppliant before them. These groups are different in the different sections, but they correspond pretty accurately with each other in the various manuscripts, and this hermetic decad is the most constant part of the manuscripts found with the mummies, though a little more extended in some than in others. (Hierogl. 4.) After these, we find 35 sections, beginning with a drop, a feather, a serpent, and a line (T); the rubric being immediately followed by the deified name peculiar to the manuscript. This exordium, from the analogy of the term sacred (n. 146), we can have no hesitation in understanding as a derivative of the feather, signifying honour or ornament, and the serpent signifying perpetuity, and in translating it, "Eternal honour" or respect. A similar sense seems, in other places, to be expressed by the open square or the pyramid, instead of the feather (U, V); and not uncommonly the hat is substituted for the line, without any variation of the meaning (W). After these 35 sections, we have two others, of which the rubrics are less intelligible, followed by 42 short ones, which evidently contain the names and titles of as many separate deities, whose figures are commonly represented in the great tablet, near that of Osiris. We may generally observe, among the epithets of each, the term "illustrious" (n. 121); and each section has a second paragraph, beginning with a pair of arms extended, a character which seems occasionally to be used in reference to the equal scales of justice, though on the stone of Rosetta it appears to signify a kind of temple, so that it may possibly relate to the honours to be paid to these divine judges. With a few additional columns, and with the great tablet of the judgment, the manuscript concludes. It does not contain the figure of the sacred cow, which is the termination of most other manuscripts; nor the agricultural representations, which are frequently found in many of them, especially in that of Lord Mountnorris (Hierogl. 3), with the three deities sitting in a grotto under it. The last of these, according to the inscriptions over the two boats, is meant for Arueris, the second apparently for the mother of the sun, and the first for Osiris; and one of the boats carries the steps, which seem to be emblematic of the solar power; the other the throne or chair of state, which is universally appropriated to Osiris.

The coffins of the mummies, and the large sarcophagi of stone, are generally covered with representations extremely similar to some of those which are found in the manuscripts. The judicial tablet is frequently delineated on the middle of the coffins; above it are Isis and Nephthe, at the sides; and apparently Rhea in the middle, with outspread wings. The space below is chiefly occupied by figures of twenty or thirty of the principal deities, to whom the deceased, in his mystical character, is doing homage; each of them being probably designated by the relationship in which he stands to the new representative of Osiris. In the sculptures, the figures are generally less numerous; the same deities are commonly represented as on the painted coffins, but without the repetition of the suppliant, and in an order subject to some little variation. The large sarcophagus of granite, in the British Museum, brought from Cairo, and formerly called the Lover's Fountain, has the name of Apis, as a part of the characteristic denomination. This circumstance, at first sight, seemed to make it evident that it must have been intended to contain the mummy of an Apis, for which its magnitude renders it well calculated; but, when the symbols of other deities were found in the mystic names upon various other monuments, this inference could no longer be considered as absolutely conclusive.

Of the votive or dedicatory inscriptions we find an interesting example on a small scale, in the engraving on the bottom of a scarabaeus, very neatly sculptured in a softish steatite, or lapis ollaris, brought from Egypt by Mr Legh, and now in the possession of Dr Macmichael. (Plate LXXVIII. X.) It is re-

markable for its simplicity, and for affording an intelligible sense in all its parts. The chain, the semicircle, and the square block, mean clearly [*To*] *the beloved;* the loop supporting a wreath or crown, and the imperfect sitting figure, resemble some of the titles often given to Osiris, and with the following oval pretty certainly signify *of the great god;* the throne, the semicircle, and the oval, *Isis;* the sitting figure, *the goddess;* the looped wreath, perhaps *the great;* the bird and circle, *offspring of;* the hieralpha or plough, and the two feathers, *Phthah;* the pillar perhaps *the powerful,* but it is not distinctly formed; the beetle seems to be here a synonym or epithet of Phthah, as if *the father of all;* the handled cross, *the living;* the lute, *the good;* the pyramid, *the prosperous* or glorious: the ring with the handle seems to be nearly synonymous with the chain, and may be rendered, in conjunction with the line and the hieralpha, *the approved of Phthah,* an epithet found in the inscription of Rosetta; the hatchet is *the deity;* the ring and handle, with the two lutes, approaches near to the symbol for munificent (n. 154), and may be called *delighting in good gifts;* and the concluding ring and staff or hatchet may either mean, this is dedicated; or may, with rather more probability, be considered as a reduplication of the beginning of the line, in an inverted position. It may be remarked, that all the inscriptions on the scarabaei run from right to left, as is most commonly observed wherever the direction was indifferent; so that if they were used as seals, the impression must have assumed the form which is somewhat less usual in other cases.

We have a most valuable example of a dedicatory inscription on a larger scale in the decree preserved on the stone of Rosetta, which, besides its utility in affording the only existing clue for deciphering the hieroglyphic characters, gives us also a very complete idea of the general style of the records of the Egyptian hierarchy. Of the triumphal monuments, the most magnificent are the obeliscs, which are reported by Pliny to have been dedicated to the Sun; and there is every reason to suppose, that the translation of one of these inscriptions, preserved by Ammianus Marcellinus, after Hermapion, contains a true representation of a part of its contents, more especially as "the mighty Apollo" of Hermapion agrees completely with the hawk, the bull, and the arm, which usually occupy the beginning of each inscription. These symbols are generally followed by a number of pompous titles, not always very intimately connected with each other, and among them we often find that of "Lord of the asp-bearing diadems," with some others, immediately preceding the name and parentage of the sovereign, who is the principal subject of the inscription. The obelisc at Heliopolis is without the bull; and the whole inscription may be supposed to have signified something of this kind. "This Apollinean trophy is consecrated to the honour of King "Remesses," crowned with an asp-bearing diadem; it is consecrated to the honour of the son of "Heron," the ornament of his country, beloved by Phthah, living for ever; it is consecrated to the honour of the revered and beneficent deity "Remesses," great in glory, superior to his enemies; by the decree of an assembly, to the powerful and flourishing, whose life shall be without end." It is true, that some parts of this interpretation are in great measure conjectural; but none of it is altogether arbitrary, or unsupported by some probable analogy: and the spirit and tenor of the inscription is probably unimpaired by the alterations, which this approximation to the sense may unavoidably have introduced.

Of the obeliscs still in existence there are perhaps about thirty larger and smaller, which may be considered as genuine. Several others are decidedly spurious, having been chiefly sculptured at Rome in imitation of the Egyptian style, but so negligently and unskilfully, as to have exhibited a striking difference even in the character of the workmanship. Such are the Pamphilian, in explanation of which the laborious Kircher has published a folio volume, and the Barberinian or Veranian: in both of these the emblems are put together in a manner wholly arbitrary; and where an attempt is made to imitate the appearance of a name, the characters are completely different at each repetition. The Sallustian obelisc has also been broken, and joined inaccurately, and some modern restitutions have been very awkwardly introduced, as becomes evident upon comparing with each other the figures of Kircher and of Zoega. Another very celebrated monument, the Isiac table, which has been the subject of much profound discussion, and has given birth to many refined mythological speculations, is equally incapable of supporting a minute examination upon solid grounds; for the inscriptions neither bear any relation to the figures near which they are placed, nor form any connected sense of their own; and the whole is undoubtedly the work of a Roman sculptor, imitating only the general style and the separate delineations of the Egyptian tablets, as indeed some of the most learned and acute of our critical antiquaries had already asserted, notwithstanding the contrary opinions of several foreigners, of the highest reputation for their intimate acquaintance with the works of Greek and Roman art. We may hope, however, that in future these unprofitable discussions and disputes will become less and less frequent, and that our knowledge of the antiquities of Egypt will gain as much in the solidity and sufficiency of its evidence, as it may probably lose in its hypothetical symmetry and its imaginary extent; and while we allow every latitude to legitimate reasoning and cautious conjecture, in the search after historical truth, we must peremptorily exclude from our investigations an attachment to fanciful systems and presupposed analogies on the one hand, and a too implicit deference to traditional authority on the other. (I. J.)

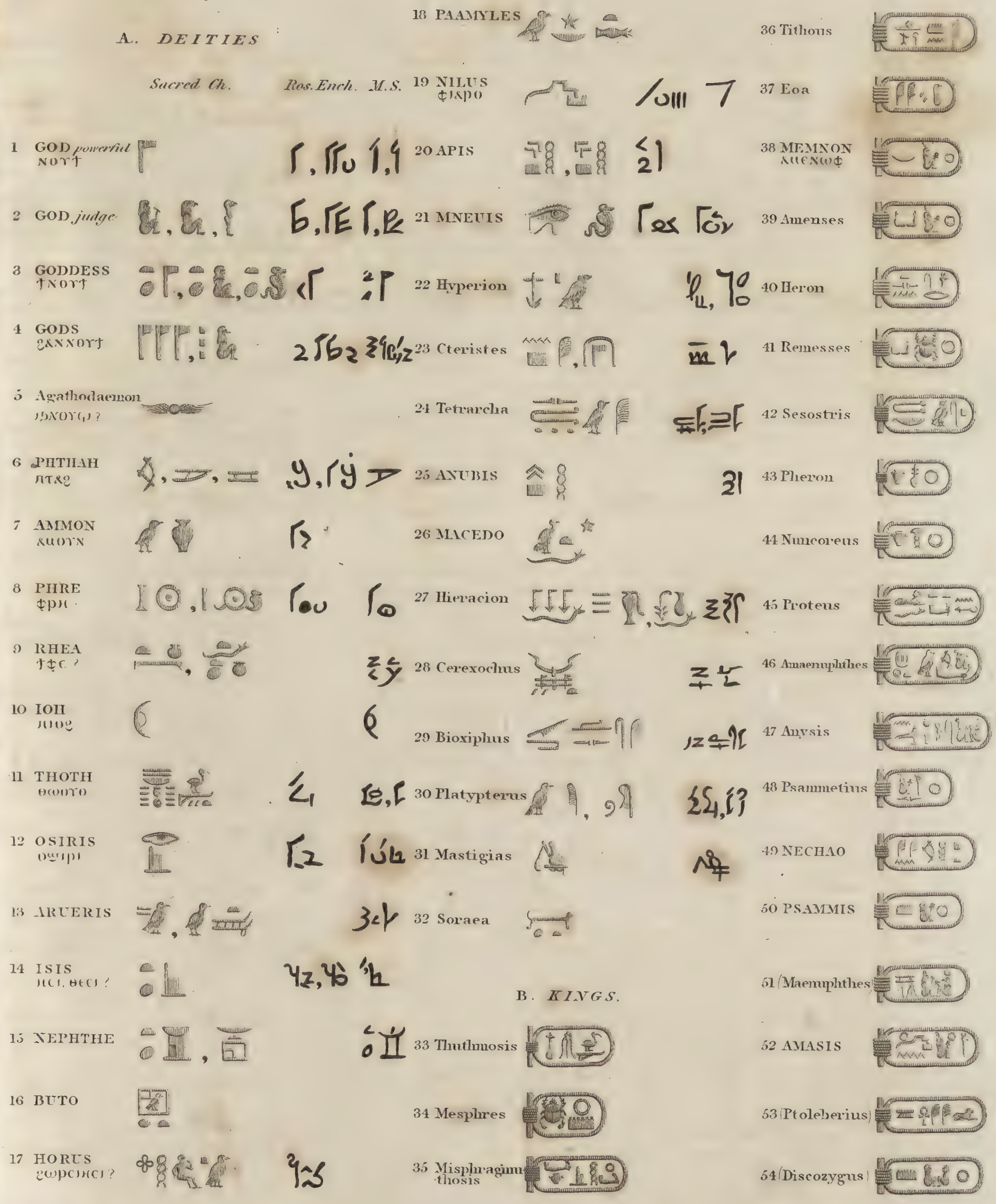
ELBA, an island of the Mediterranean, separated by a narrow channel from the western coast of Italy. It lies in 42° 49′ 6″ N. Lat., and 10° 9′ 24″ E. Long. from London. It is about 70 English miles in circuit, but the coast is very winding and irregular.

Elba is supposed to have been first peopled by a colony of Etruscans, but was afterwards occupied by a body of those Greeks who founded Marseilles. It fell afterwards under the dominion of Carthage, and was taken by the Romans during the first Punic war.

EGYPT.

PLATE LXXIV.

HIEROGLYPHICKS.



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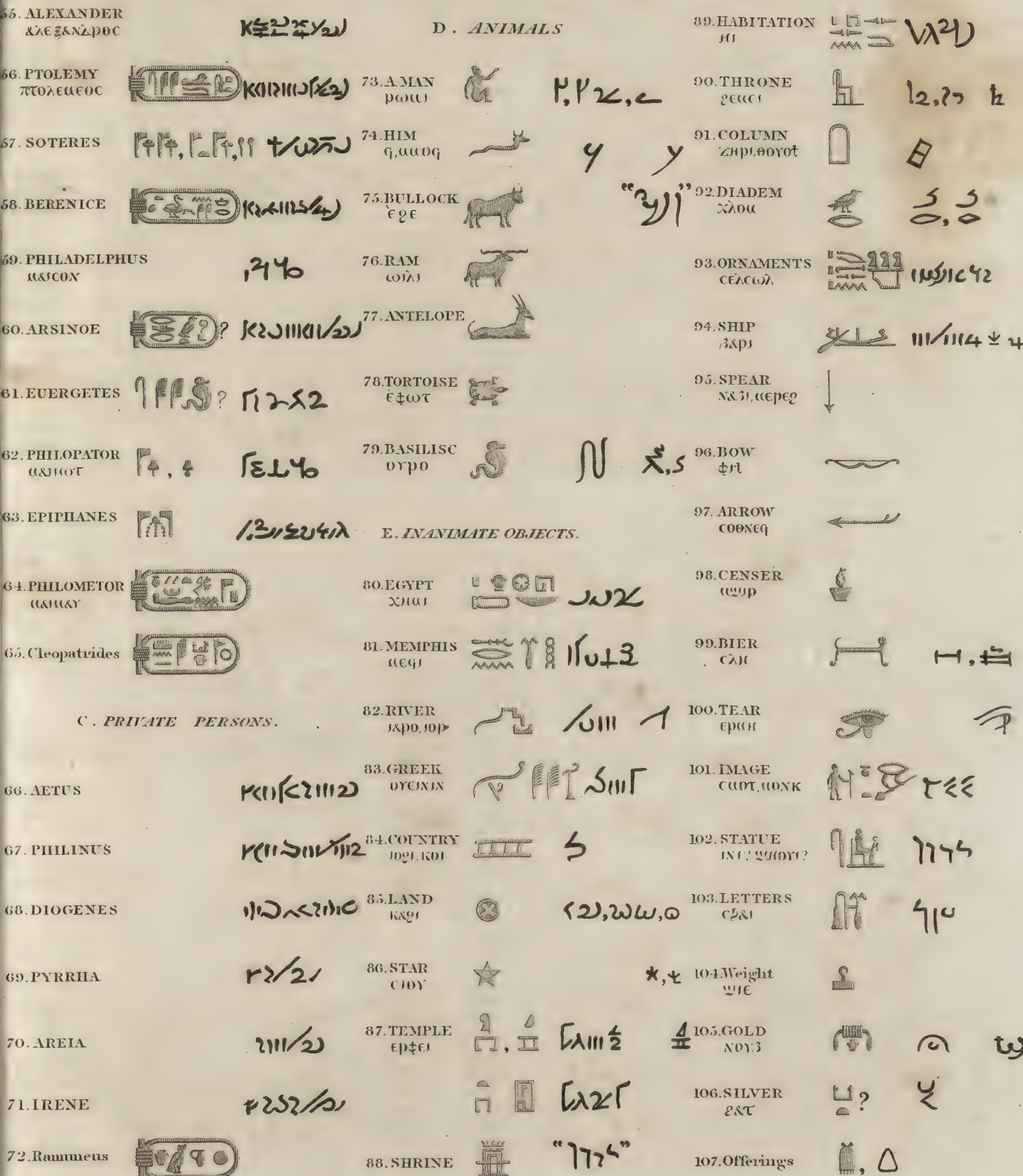
Edm.d Turrell, sculp.

HIEROGLYPHICKS.



Published by A. Constable & Co. Edinr. 1819. *Edmd. Turrell, Sculp.*

HIEROGLYPHICKS.

F. *ATTRIBUTES AND ACTIONS*

. LIFE ωΝϨ, ΑϨΙ
. ETERNITY ⲈΝΕϨ
. IMMORTAL ΕΤΟΝϨ ⲈΝΕϨ
. JOY ϨΜΟΤ? ΡΑϢΙ?
. POWER ϪΟΜ
. STABILITY ΤΑϪΡΟ
. ESTABLISHED ΤΑϪΡΗΟΥΤ
. STRENGTH ΑΜΑϨΙ
. MIGHTY ϪΟΡ
. VICTORY ϬΡΟ
. FORTUNE
. SPLENDOUR ωΟΥ, ΟΥωΙΝΙ
. BEARING ϬΑΙ
. ILLUSTRIOUS ΦΕΡΙωΟΥ
. HONOUR ΤΑΙΟ
. RESPECTABLE Μ?ΜΠϢΑ?
. VENERABLE ΝΙϢΤ? ΝΑΙΑΤ?
. RITE ΠΕΤϹϢΕ

126. WORPSHIP ϢΑΜϢΕ
127. FATHER ΙωΤ
128. MOTHER ΜΑΥ
129. SON ϢΗΡΙ
130. ATTENDANT ΒωΚ? ϢΦΗΡ?
131. DAUGHTER ϢΕΡΙ
132. SONS ΝΙϢΗΡΙ
133. CHILD ΑΛΟΥ
134. DIRECTOR ΡΕϤϹΟΥΤΕΝ?
135. STEERSMAN ΡΕϤϨΕΜΙ
136. ROWER ΡΕϤΒΟϹΕΡ?
137. KING ΟΥΡΟ
138. CONDITION ΜΕΤ . . .
139. KINGDOM ΜΕΤΟΥΡΟ
140. LIBATION ωΤΕΝ ⲈΒΟΛ
141. CEREMONY ϢΛΗΛ?
142. PRIEST ΟΥΗΒ, ϨΟΝΤ
143. PRIESTHOOD ΜΕΤΟΥΗΒ
144. SACERDOTAL ΝΤΕ ΝΙϨΟΝΤ

146. ASSEMBLY ϢΑΙ
146. SACRED ΟΥΑΒ
147. CONSECRATED ΘΟΥωΤ?
148. GIVE Ϯ
149. OFFER ΕΝ, ΙΝΙ
150. DEDICATE ΤΑϨΟ?
151. LAWFUL ΘΜΗΙ
152. GOOD ΝΑΝΕ
153. BESTOWING ΕΤϮΝϨΜΟΤ
154. MUNIFICENT ΡΕϤΝΑΝΕϤ
155. GREAT ΝΙϢΤ, ΝΑΑ
156. OTHERS ΚΕϪωΟΥΝΙ
157. CALLED ΕΤϪω
158. DECLARATION ωϢ, ϨωΠ
159. MANIFEST ΕΤϹΟΥΕΝ
160. NAME ΡΑΝ
161. ENLIGHTENING ΡΕϤΕΡΟΥωΙΝΙ
162. LOVING ΜΑΙ, ΜΕΝΡΗΤ
163. PRESERVER ΕΘΝΟϨΕΜ

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HIEROGLYPHICKS.

SET UP
..ⲟ ⲉⲣⲁⲧ

PREPARE
ⲥⲉⲃⲧⲉ

G. RELATIONS.

IN ORDER THAT
ϩⲓⲛⲁ

WHEREVER
ⲡⲓⲙⲁ, ⲉⲟⲩⲙⲁ

AND
ⲟⲩⲟϩ

ALSO, WITH
ⲛⲉⲙ

MOREOVER
ⲛϩⲟⲩⲟ?

LIKEWISE
ⲙ̀ⲡⲁⲓⲣⲏϯ

IN
..ⲉⲛ, ⲉϩⲟⲩⲛ

UPON, AT
ϩⲓ, ⲉϩⲣⲏⲓ

OVER, ON
ⲉϫⲱ

FOR
ϣⲁ

BY THE
(ⲕⲁⲧⲁ), ⲛⲧⲉ?

OF, TO
ⲛⲧⲉ, ⲛ

H. TIME

DAY
ⲉϩⲟⲟⲩ, ⲙⲉⲣⲓ

MONTH
ⲁⲃⲟⲧ

YEAR
ⲣⲟⲙⲡⲓ

181. THOYTH
ⲑⲱⲟⲩⲧ

182. MECHIR
ⲙⲉⲭⲓⲣ

183. MESORE
ⲙⲉⲥⲱⲣⲏ

184. FIRST DAY
ⲥⲟⲩⲁⲓ

185. THIRTIETH
ⲥⲟⲩ ⲙⲁⲃ

I. NUMBERS

186. ONE
ⲟⲩⲁⲓ, ⲟⲩⲓ

187. FIRST
ϩⲟⲩⲓⲧ

188. TWO
ⲥⲛⲁⲩ, ⲥⲛⲟⲩϯ

189. SECOND
ⲙⲁϩⲥⲛⲁⲩ

190. THREE
ϣⲟⲙⲧ

191. THIRD
ⲙⲁϩ ϣⲟⲙⲧ

192. THRICE
ϣⲟⲙⲧ ⲛⲥⲟⲡ

193. FOUR
ϥⲧⲟ

194. FIVE
ϯⲟⲩ

195. SEVEN
ϣⲁϣϥ

196. EIGHTH
ⲙⲁϩϣⲙⲏⲛ

197. TEN
ⲙⲏⲧ, ⲙⲏϯ

198. SEVENTEEN
ⲙⲉⲧϣⲁϣϥ

199. THIRTY
ⲙⲁⲃ

200. FORTY TWO
ϩⲙⲉⲥⲛⲁⲩ

201. A HUNDRED
ϣⲉ

202. A THOUSAND
ϣⲟ

203. MCDXXVIII
ϣⲟ ϥⲧⲟ ϣⲉ ϫⲱⲧ
ϣⲙⲟⲩⲛ

204. SEVERAL
ϩⲁⲛ, ..ⲟⲩⲓ

K. SOUNDS?

205 ⲃⲉⲣⲉ
206 ⲃⲓⲣ
207 ⲉ
208 ⲉⲛⲉ
209 ⲓ
210 ⲕⲉ, ⲕⲏ
211 ⲙ, ⲙⲁ
212 ⲛ
213 ⲟⲗⲉ
214 ⲟϣ. ⲟⲥ
215 ⲡ
216 ϥ
217 ⲧ
218 ⲱ

SUPPOSED ENCHORIAL ALPHABET.

ⲁ
ⲃ
ⲧ, ⲕ, ϭ
ⲇ
ⲉ
ⲏ
ⲓ
ⲗ
ⲙ
ⲛ
ⲟ
ⲡ, ⲫ
ϥ
ⲣ
ⲥ, ϣ
ⲩ
ⲭ
ⲱ
ϩ
ϫ

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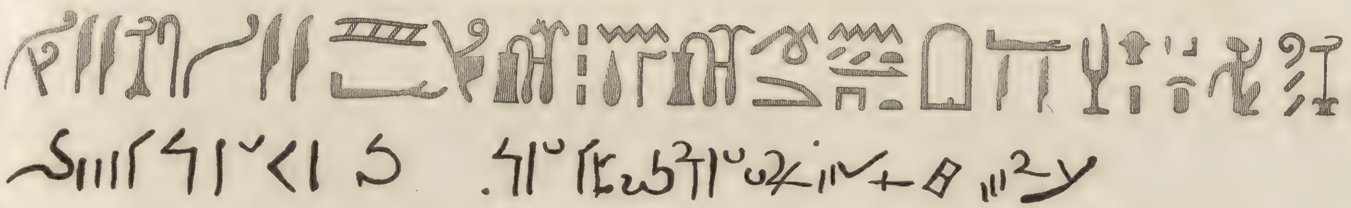
Edmd. Turrell Sculp.

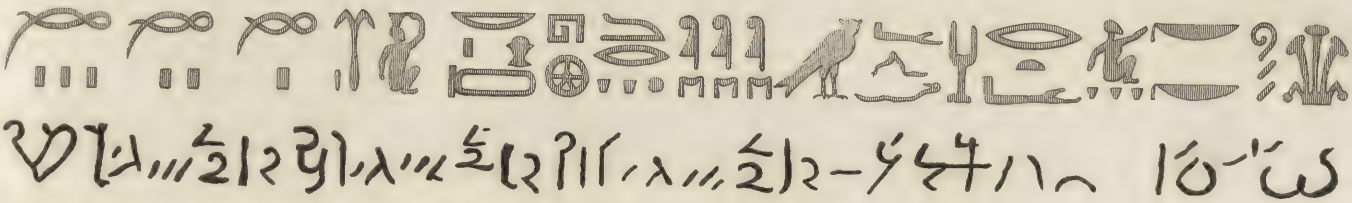
EGYPT.
HIEROGLYPHICKS.
PLATE LXXVIII.

L. *ADDITIONS* 21* Damalis 78 * CROCODILE a , b 156* UPPER, LOWER

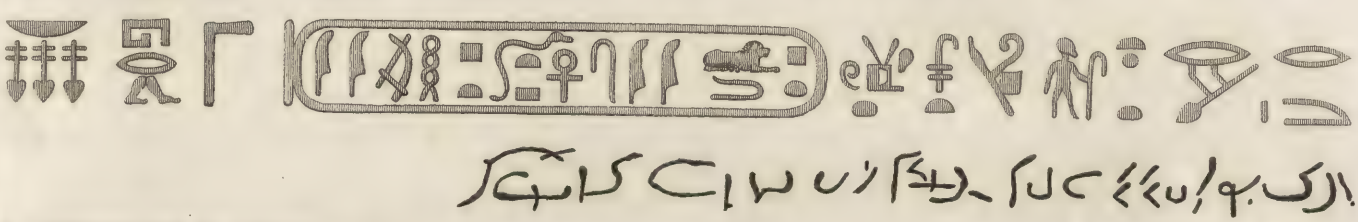
M. *SPECIMENS OF PHRASES. ROS. INSCR. LAST LINE.*



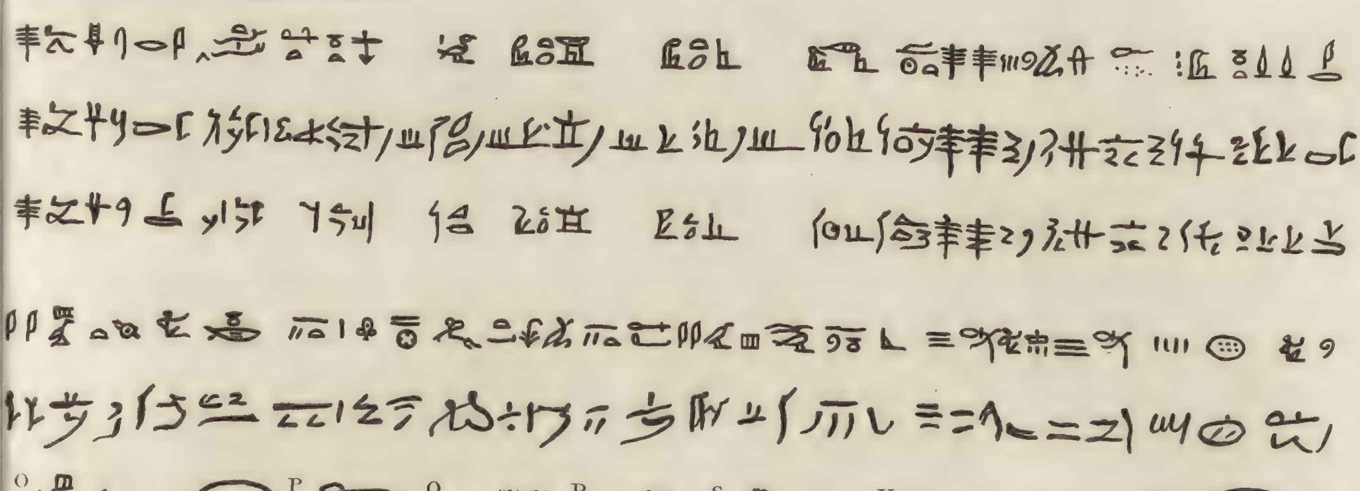
.... ΣΤΕΡΕΟΥΛΙΘΟΥ ΤΟΙΣΤΕΙΕΡΟΙΣ ΚΑΙ ΕΓΧΩΡΙΟΙΣ ΚΑΙ ΕΛΛΗΝΙΚΟΙΣ ΓΡΑΜΜΑΣΙΝ

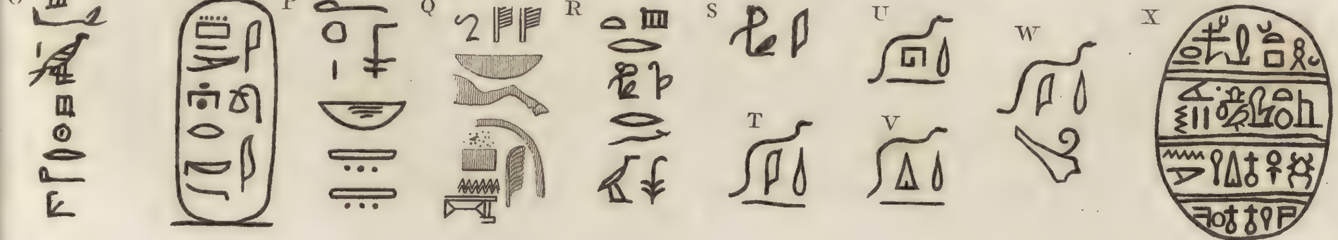


ΚΑΙΣΤΗΣΔΙΕΝΕΚΑΣΤΩΙΤΩΝΤΕ ΠΡΩΤΩΝ ΚΑΙΔΕΥΤΕΡΩΝ ....



N. *COMPARISON OF MANUSCRIPTS.*





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Engraved by E. Turrell.

Elba.

In the second, Elba supplied iron for naval and military purposes, and was considered as one of the states which had saved the republic. In the contest between Sylla and Marius, the adherents of the latter fled thither for refuge, and Elba became thus involved in prescription and devastation, from the effects of which it never recovered under the Roman dominion. In modern times, it became attached to the commercial republic of Pisa, under whose auspices it rose to a comparatively flourishing state. On the annexation of Pisa to Milan, Elba, with Pianosa, Monte Cristo, Piombino, and other territories, was formed into a little principality, which continued for about two centuries in the hands of Gherardo d'Appiano and his successors; though it was repeatedly occupied as a military station by Charles V. and his ally, the Grand Duke of Tuscany. Being thus involved in the wars of that monarch with the Porte and the Barbary states, Elba became exposed to the incursions of the Turkish corsairs. It was laid waste with fire and sword, once by Barbarossa, and twice by Dragut, and has never fully recovered from these ravages. Under Philip III. it merged into the possessions of Spain. and that prince ordered the construction of Porto Longone, which proved a barrier against the incursions of the corsairs. Several transferences then took place, the result of which was, that, from 1735, the King of Naples had possession of Porto Longone, and the Grand Duke of Tuscany of Porto Ferraio. Elba continued in this state till the French revolution, when it first became part of the kingdom of Etruria, and was then annexed to France. It afterwards attracted a remarkable degree of attention, by becoming the temporary residence of Napoleon Buonaparte. Upon his second downfall, Elba was ceded to the Grand Duke of Tuscany.

The island of Elba is entirely filled with mountains, which are formed into three distinct clusters, separated by a valley, which widens as it approaches the sea. The highest are those situated on the western part of the island, the pinnacle of which, called Monte Capanna, rises upwards of 3000 feet above the level of the sea. The greater part of these hills present an arid, rugged, and often ruinous aspect; but a few are embellished with myrtles, laurels, wild olives, and other verdant shrubs. This western part is almost entirely composed of granite, which forms also the basis of the soil in this quarter of the island. Rock crystal is found abundantly, and often in large masses, but somewhat injured in its transparency, and when combined with alum and slate, produces numerous varieties of calcedony, particularly that called *cachalong*. The eastern mountains are composed of serpentine and schistus, and abound with aluminous mixtures; but they are chiefly distinguished by the iron which they contain.

From the earliest times, Elba has been celebrated for an uncommon iron mine. It is said by Pliny to have been mentioned in the treaty between Porsenna and the Romans, after the expulsion of the kings. Virgil calls it

"Insula, inexhaustis chalybum generosa metallis."

This mine consists of one entire mountain, about 500 feet high, and bathed by the channel which separates the island from the opposite coast of Piombino. The whole mountain is filled with iron, distributed in confused masses, and in every known variety of form; green and black ore, mica, manganese, hematite, &c. The most rare and remarkable mineral here produced is the crystallized iron. The crystals are of various forms, some lenticular, others specular, with brilliant and polished fronts; others shaped like the comb of a cock, spires, pyramids, &c., while others are polygons and pointed, like diamonds. They have usually the colour and brightness of polished steel, but are sometimes tinted green, red, black, yellow, brown, and violet. A few pieces offer to the enchanted eye the appearance of an assemblage of all the precious stones. The mineralogical cabinet of Florence contains a splendid collection of these specimens, and there are some good ones in the British Museum. The mine of iron extends about a mile into the mountain, and the working was formerly conducted by galleries, but now proceeds under the open sky. The Elbese do not possess the art of forging this iron, which is therefore carried to the founderies of Corsica, and of the opposite coast of Italy. About 18,000 tons are sold, and about 120 vessels, of from 40 to 100 tons each, are employed in exporting it to the neighbouring coasts.

The soil of Elba is unequal, and wants depth; in consequence of which, and of the want of industry in its inhabitants, scarcely any corn is raised. They grow, however, maize, pease, beans, and other species of pulse. Fruits are in general bad; but figs and chesnuts are very plentiful, and the olive and mulberry flourish through the greater part of the island. The most valuable vegetable produce is the grape. The white wine is common, and used only at home; but the red wine is exquisite, though in small quantity; and there are two kinds of dessert wine, both highly esteemed, called *Vermont* and *Aleatico*. Wood, both for fuel and carpenter's work, is very scarce; yet Elba produces two remarkable trees, the American aloe and the Indian fig, both of which attain a greater height here than in other parts of Italy. The tunny fishery is considerable, and is carried on both at Porto Ferraio and Marciana. The tunnies visit this coast twice in the year, from April to July, and from September to the end of October. The fishery forms a sort of festival; the sea is covered with boats, which form a vast enclosure, into which, when the tunnies have entered, they are pierced with harpoons, and the sea is reddened with their blood. The annual amount is about L. 2500 Sterling. Pearl oysters were formerly caught, but this fishery has been exhausted. There are numerous marine marshes from which salt is evaporated, though the manufacture is not well conducted. The produce is 60,000 sacks, of about 150 lbs. each.

The population of Elba was, in 1778, estimated at 8000, but it has since risen to 12,000 souls. They are a race differing, in many respects, from that which inhabits the continent of Italy. They are well made and robust, and often attain a great age without experiencing ailment or infirmity. They are brave, active, hardy, laborious, and, at the same time, kind-hearted and hospitable. They are, however, irritable and impatient of contradiction. They

are almost universally ignorant and credulous, yet have a certain liveliness of imagination, which renders them fond of extravagant and romantic tales. The females are not in general handsome, but to this there are some exceptions; they are generally virtuous, and make good wives and mothers.

The principal town of Elba is Porto Ferraio, which contains a population of 3000 souls. The houses are small and inconvenient, but the streets are wide, and are in general terraces cut in the rock. Vast subterraneous magazines have been here constructed for the preservation of corn and other necessaries, with a view to provisioning the place in case of siege. The inhabitants are said to have lost the simplicity of the rural districts, without attaining any real information or refinement. Porto Longo is a well fortified town, with an agreeable and picturesque neighbourhood, and contains 1500 inhabitants. Rio is poor, and is only supported by the great iron mine, which is situated in its neighbourhood; its population may be 1800 souls. Other villages and districts are Capo Liveri, Campo, and Marciano.—*Voyage to the Island of Elba.* By Arsenne Thiebaut de Berneaud, translated by W. Jordan, 8vo. 1814.—*Tour through the Island of Elba.* By Sir Richard Colt Hoare, Bart. 4to. 1814. (B.)

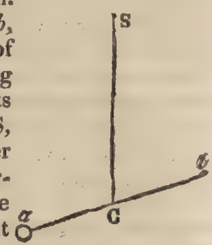
ELECTRICITY.

Most of the *phenomena* which Electricity presents have been described at large in the Encyclopædia; and the *experimental* part of the science remains nearly in the same state as at the publication of that work. This is not the case, however, with the *theoretical*. The theory was then founded on suppositions more or less doubtful; on ingenious but contracted views of the subject; and rather on empirical relations among the phenomena than on calculations rigorously mathematical. It is to supply this defect, that we must especially devote ourselves in this Supplement, and happily the progress of science affords ample materials.

To proceed methodically in the concentration of the electrical phenomena, let us recal successively all the general laws in which they are recorded, and which are established by experiment. The first consists in the mutual attraction or repulsion which electrified bodies exert, or *seem to exert*, towards each other. These properties are exhibited when we electrify a tube of glass or of resin, by rubbing it on a woollen cloth, and then touch with this tube small and light balls of wood, or the pith of the elder, suspended in a dry state of the air by threads of silk equally well dried. In this case, the silk prevents the escape of the electricity, and the air also possesses the same faculty. The little balls being only in contact with insulating bodies, are thus protected from any waste of their power. They are what we term *insulated*. But the moment the electrical property is *communicated* to them, they mutually fly asunder, and, contrary to the tendency of gravity, recede from the vertical; precisely as if the electricity which attaches itself to their surfaces had determined them to repel each other.

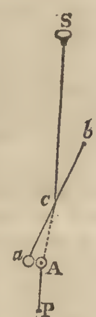
The result is alike, whether the little balls have been touched with the tube of glass or with that of resin, provided both are touched with the same. But, if one of them be touched with the tube of resin, and the other with the tube of glass, these two tubes having been both rubbed on a rubber of the same nature, then the two balls approach each other, contrary to the tendency of gravity, as if by a mutual attraction. This result being opposite to the first, obliges us to distinguish two modifications of electricity different from each other, at least in the apparent effects which they produce. These are what have been termed *positive and negative electricity*. We shall not employ these terms on account of their already presenting to the mind the ideas of *addition* and *subtraction*, which are really hypothetical, since they go beyond the facts. To express the distinction between the two kinds of electricity, we shall name them according to the method which serves to develope their influence. We shall call that *vitreous electricity* which a tube of glass exhibits when rubbed on a rubber of wool, and that *resinous electricity* which is obtained on rubbing upon the same rubber a tube of resin; though either of these electricities could be yet produced by some other proceeding different from what we have indicated in this definition.

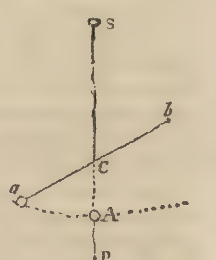
We must now seek, by experiment, for the law according to which these attractions and repulsions operate, that is to say, what their relative intensity may be at different distances. The separation of the little balls furnishes an index of this; but it is not sufficiently delicate, and, as we shall soon see, too complicated, to measure it with exactness. The same may be said of all the contrivances in which weights so small as they must necessarily be, are made to balance the attraction or the repulsion. The *torsion* of metallic wires is the only force sufficiently minute, sufficiently constant, and whose effect can be estimated with sufficient ease, to be employed with advantage in measurements of this kind. Such is the object of the *electrical balance* of Coulomb, described in the *Encyclopædia* under the word *Electrometer*, and represented in the annexed figure. (1.) In what follows, we shall suppose the reader to have that description before him.



A small horizontal lever *ab*, formed by a very fine thread of gum lac, a powerful insulating substance, is suspended by its centre to a metallic wire, CS, two or three feet long. This lever at one of its extremities, *a*, carries a little ball of the pith of the elder, or a small plane of gilt paper, balanced by a slight swelling formed at *b*, the extremity of the other arm.

Electricity. The small lever being supposed thus freely suspended and balanced, if we attempt to turn it any number of degrees in the horizontal plane in which it is situated, this cannot be done without twisting in the same degree the metallic wire SC, to which it is attached. But this wire, by virtue of its elastic reaction, will resist the torsion with a force, depending on its dimensions, on its nature, and on its physical constitution; and, according to Coulomb's experiments, so long as its state of aggregation has not received a permanent alteration, by twisting, its resistance will be exactly proportional to the angle by which we withdraw it from its natural position of rest; proportional, therefore, in this case, to the angle which we cause the small horizontal lever *ab*, to describe. (See Biot, *Traité de Physique Experimentale*, Tom. I. and II.) We have only, therefore, to produce this angular deviation by means of the electrical repulsion, and the torsion of the wire will measure its effect. For this purpose, the lever *ab*, being in that position of rest to which the natural equilibrium of the wire tends to carry it, we place beside the ball *a*, another ball A, (fig. 2.) of the same or of a different diameter, but fixed upon an immoveable and insulating support, formed also of a short and very fine thread of gum lac. The two balls being now in contact, we touch the fixed ball A, with the extremity of an electrified tube. The electricity then divides itself between the two balls, the one fixed, the other moveable; these fly from each other, and this repulsion forces the lever, *ab*, to turn round its centre, (fig. 3.) until the repulsive force, weakened by the distance, is exactly balanced by the force of torsion of the suspending wire SC. Hence arises a state of equilibrium which is attained after several oscillations. We now observe, upon a divided circle which surrounds the apparatus, the arc A*a*, which the lever has described; and turning the button S, by which the wire is suspended, and which is itself divided on the circumference, we twist it round a certain number of degrees until the angular distance of the balls becomes the half, the fourth, the eighth, or any other fraction of what it was at first; and then by comparing the degrees of torsion with the angles where the ball *a* stops in every case, we obtain the relative values of the repulsive force at various distances. In this manner it has been found by Coulomb that this force, like that of the celestial attraction, is rigorously proportional to the quantity of free electricity upon each body, and reciprocally as the square of their mutual distance. An experiment of a similar kind demonstrates that the same law extends also to the attractive force of the bodies charged with different electricities; and the sensibility of the apparatus is such, that no doubt can remain of the accuracy of the result. The only source of error would arise from the waste of electricity which is continually going on, through the air, and through the supports of gum lac, which, though highly insulating, can never be obtained in this respect altogether perfect. But the above mode of experimenting may itself serve to estimate the effects of these two causes. For we have only to leave the two bodies *a* and A near each other for a considerable time, several hours for example, taking care to untwist, from time to time, the wire SC, in order to diminish its resistance, and replace the balls at the same distance from each other in proportion as their repulsive force diminishes by the progressive waste of the electricity which covers them. It is easy to conceive that experiments of this nature, properly varied, ought to show the law of the waste of electricity through the air and along the supports. It was, accordingly, in this manner that Coulomb determined it; he was thus enabled to correct all his results, and to bring them up to the mathematical case of air perfectly dry, and of supports completely insulating; and it is with these corrections that the law of the squares of the distances comes out with the utmost rigour, as above enunciated. The apparatus employed by him for this purpose, and which we have explained (fig. 2, 3), he called the *electrical balance*.





What renders the torsion of the metallic wires peculiarly adapted for these kind of experiments is its extreme sensibility, by which the slightest variation in the intensity of the attractive or repulsive force produces an enormous change in the angle of torsion, which we must communicate to the metallic wire in order to balance it. In the experiments, for example, related by Coulomb,—to turn the lever *ab* a whole circumference, it was only necessary to apply to one of its extremities a force equal to the weight of $\frac{1}{279}$ of a Troy grain.

Another remarkable result presents itself in these experiments. Whatever be the matter of which the balls are composed, provided that they are electrified simultaneously as we have supposed, the electricity divides itself between them always in the same ratio. If they are equal in volume, this ratio is that of equality; if they are unequal, the allotment follows a proportion depending on their diameters; but the chemical nature of the substance has no influence whatever. This may be proved by the following experiment: When the moveable ball *a*, of the balance, has been electrified simultaneously with the fixed ball A, and has receded to a certain distance, where the repulsive force maintains it in equilibrio with the force of torsion of the wire; touch the fixed ball A, with another ball of the same diameter insulated at the extremity of a small cylinder of gum lac, and withdraw it immediately after the contact; the electricity of the fixed ball will now be reduced exactly one-half, as the moveable ball will indicate by the new distance at which it will place itself. Now, this same reduction of one-half takes place whatever be the chemical nature of the ball with which the contact is effected. This fact proves, that the electricity is not retained in the balls by a chemical affinity

for the material substance of which they are composed; and thus furnishes one great character which the theory must admit and represent.

In place of balls, we may equally well employ in these experiments small circular disks of gilt paper; or any other bodies, whatever be their form, provided their dimensions are very small, compared with the distance at which we make them act upon each other: this condition is, in fact, the only one which is necessary for making all the quantities of electricity which they possess to act together as if they were united in one single point. But the spherical form, and the circular, have peculiar advantages, arising even from the very manner in which electricity disposes itself in the bodies where it is in equilibrio, as we shall afterwards explain.

This mode of disposition is the first thing to which we must now attend. For, if we succeed in determining it by experiment, it will furnish us with geometrical characters, which the theory ought to satisfy, and which consequently will throw light upon the conceptions by which electricity may be represented. This determination is still obtained by means of the torsion balance. For this purpose we prepare a small circular disk of gilt paper, P (fig. 4.) which we insulate by fixing it to the extremity of a very fine cylinder of gum lac, SP; we insulate also, as completely as possible, the body which we mean to study, and then electrify it by communicating a spark drawn from a Leyden phial, or an electrophorus. If we now wish to know the state of any of the points of its surface, we touch this point with the little gilt disk, which we shall call the *proof plane*, and which, in this experiment, we hold by the extremity S of its insulating support, SP. We then carry this plane in the electrical balance, where the moveable ball has been previously charged with an electricity of the same kind, and place it for an instant in contact with the fixed ball. We then withdraw it, and the fixed ball being now electrified in the same manner as the moveable one, repels this with a force measured by the angle of torsion, at which the moveable ball stops. While the little plane and the balls of the balance remain the same, the division of the electricity between the little plane and the moveable ball, follows a constant proportion; thus the repulsive force which results, and which drives off the moveable ball, is proportional to the quantity of electricity with which the little plane is charged. But, moreover, experience proves that this is proportional to the quantity of electricity which really exists at the point of the body where we made the contact. The repulsive force, therefore, exerted by the fixed ball, is, likewise, proportional to that quantity of electricity, and thus the torsion observed will give us its measure. By repeating the same proof upon various other points of the body which we submit to experiment, we may determine the manner in which the electricity is distributed throughout.

This supposes only that the body and the balls of the balance are perfectly insulated, and lose none of their electricity while the experiments last. This constancy can never be made to hold with rigour, but we can correct its effect in a very simple manner. For this purpose, compare all the points m, m', m'', of the body with a single point, which we shall denote by M. To compare the state of m, begin by touching M with the proof plane, and determine by means of the torsion balance, the intensity of the repulsive force. Then, having deprived the fixed ball of the electricity which had been communicated to it in this experiment, touch m with the proof plane, and determine, in like manner, the repulsive force which results. Observe the time that elapses between these two comparisons, and suppose, for example, that it is a minute. In a minute after the second experiment, try again the state of M, and take the mean of the two values of the repulsive force, which this point will have furnished. The second will be weaker than if M and m had been both tried at the same time; but the first will be stronger; and if the waste is very slow, as the precautions we have indicated suppose it to be, the arithmetical mean between the two results will be the same that would have been obtained at the intermediate instant, that is to say, when the observation was made upon the point m. This corrective process, so simple and so exact, was imagined and employed by Coulomb, who, in general, has left but little to be added as to the use of his ingenious apparatus.

The method of *alternate contacts* which we have explained, may be employed to discover the disposition of electricity, not only at the surface of bodies, but even in their interior. For this purpose, it is sufficient to pierce in the body a small canal, terminating on its surface, and to plunge the proof plane to the bottom of this canal, when the body is electrified and insulated. In this manner the remarkable result has been obtained, that, whatever be the external figure and substance of the body, provided it be a conductor, the electricity will remain nowhere in its interior. It will confine itself entirely to its surface, where it will form a stratum infinitely thin; and this fact, demonstrated by Coulomb, forms another capital basis for the theory.

In regard to the distribution on the surface, it depends on the form of the body. In spheres, for example, the electricity is distributed in a spherical stratum of a constant thickness. On an ellipsoid of revolution, the thickness is variable. The exterior surface of the stratum is that of the body itself, and the quantities of electricity at the extremities of the greater axis are proportional to its length. Lengthen, then, considerably, the ellipsoid, and the thickness of the stratum will augment at the extremities of its greater axis in the same proportion. If the resulting force of repulsion is then sufficiently powerful to overcome the resistance which the ambient air presents to it, the electricity will escape by the points; and this gives the reason that it escapes at the corners of all angular bodies. In general, whatever be the exterior form of the electrified body, this form constitutes the exterior surface of the electrical stratum. As to the interior surface, it always differs infinitely little from the first. But its deter-

mination can only be expressed by analytical conditions, deduced from theory, and which experiment demonstrates to be conformable to the truth.

The method of alternate contacts serves also to measure another phenomenon of capital importance. This is the developement of electricity in conducting bodies *by the influence at a distance*, of bodies already electrified. When a body A, for example, which we shall suppose, for greater simplicity, to be spherical, has been electrified and insulated, if we then bring within a certain distance of it a body B, a conductor of electricity, and equally well insulated, but not previously electrified; this latter, as it approaches the other, begins to give signs of electricity; it ceases, however, to do so when we remove it again to a great distance, and it recovers this virtue, or loses it, according as we expose it to, or withdraw it from, the influence of the body already electrified. The philosophers who first discovered this fact supposed, in order to explain it, that every electrified body sent forth electrical emanations, which spread around it *like an atmosphere*, and electrified every conducting body which one might plunge into it. But as this effect is produced even through bodies such as glass, for example, which do not allow the electricity to pass through their substance, it is evident, that, if we wish not to go beyond the facts, we ought not to view this but as a certain influence exerted at a distance, like what is observed in the celestial attraction, and in the magnetic attractions and repulsions. Now, to study the effects and the laws of this influence, we must place the conducting and insulated body B, before the electrified body A, and so near it as to give evident signs of electricity; then touch different points of its surface with the proof plane, and study with the electric balance the nature and the quantity of the electricity which is developed in each of them. In making this experiment we find the following result: The electricity developed in B is not every where of the same nature; it is similar to that of A in the portion of B which is most distant from A, and different in that which is nearest. If A, for example, is charged with vitreous electricity, the anterior part of B, that towards A, is in the resinous, the posterior, in the vitreous state; and between these two extremes each of the two electricities extends in a certain zone, which may be determined by the proof plane. But in all cases the total quantities of the different electricities distributed over these zones have the remarkable property of being exactly equal, so that, if left to themselves, they would neutralize each other's effect. This supposes that B, before being submitted to the influence of A, was in the natural state; but if it has already received a certain quantity of electricity, we then find that the sums of the vitreous and resinous electricities which it possesses under the influence of A, do not differ from each other but by this primitive quantity; and hence we re-obtain it entire when we withdraw B from the influence of A, and deliver it to its natural state of electrical equilibrium. In every case, however, as it is natural to expect, this constancy only holds when we suppose the body B to lose none of its primitive or acquired electricity, either by the contact of the air, or the imperfection of the insulating supports. It is understood, therefore, that we correct the effect of these two sources of waste, by the laws already mentioned, which are determined for each of them by experiment. With the same condition we may study the electricity of A by the proof plane, either when it is abandoned to itself, or when it acts on B; and in this manner, we find that this action takes away from it absolutely nothing of its primitive electricity; but that when B is near A, and influenced by it, A is also influenced in its turn, so that the electricity we have given it is distributed in a different manner; and if the distance of B is small, or the reciprocal action energetic, the electricity ceases even to be of the same nature over all the surface of A. The part nearest to B takes the contrary electricity to that which the anterior part of B possesses, and the more distant takes the opposite. In a word, every thing here is reciprocal, in regard to the two bodies, and the effects are only in proportion to the difference of their form, and of the quantities of external electricity which they primitively possessed.

The enunciation alone of these results is sufficient to point out the consequences. *1st*, Since the body B takes nothing from the electrified body A, it must possess within itself the principles of the two electricities which are developed in it by the influence of this body. *2dly*, Since these two electricities disappear when the influence of the external body ceases, although they cannot escape into the ground, on account of the insulation of B, their proportions must be such, that, being left to themselves, they will mutually neutralize each other. *3dly*, This neutralization must operate without destroying these electricities, since they appear anew and quite entire every time we submit the body B reduced to its natural state, to the influence of the electrified body A.

We are thus led to discover, that the principles of the two electricities exist naturally in every conducting body, in a state of combination which neutralizes their effects. This we shall henceforth call the *natural state of bodies*. We see also that friction, which seems, at first view, a method of generating the two electricities, serves only to disengage them from their mutual combination, and to render the one of them sensible by absorbing the other; and this is the reason, without doubt, that we constantly observe the rubbing and the rubbed body exhibit contrary electricities. In fine, since the sole influence of an electrified body presented at a distance to another body in the natural state, forces the two electricities of that body to separate and to distribute themselves in such a manner that those of a different nature become the nearest to each other upon the two bodies, and those of the same nature the farthest, we must, in order to enunciate this fact, admit, that the electrical principles *of a different name attract, and those of the same name repel, each other*, according to laws which experience may perhaps enable us hereafter to determine.

These observations lead to another important consequence. When we begin to examine the electrical phenomena, we perceive that electrified bodies

attract, or seem to attract, all the light bodies which are presented to them, without there being any necessity, for this purpose, of developing first the electric faculty in these, either by friction or communication. But we must now conceive, that this developement goes on of itself, by the sole influence at a distance of the electrified body, on the combined electricities of the little bodies which we present to it; so that, even in this case, the attraction, whether real or apparent, that we observe, does not take place but between bodies that are really electrified.

Moreover, the developement of the combined electricities in these circumstances is indispensable, in order that the attraction may take place; for the latter is always the less vigorous as the former is effected with less facility. To be convinced of this, take two threads of raw silk, very fine, and of equal lengths. Suspend to them two little balls of equal dimensions, of which the one is of pure gum lac, and the other also of gum lac, but gilt on its surface, or coated with tin-foil; these two pendulums being then placed beside each other, and at a small distance, bring near them a tube of glass or of sealing wax, rubbed and electrified; you will see that the ball covered with metal, and on whose surface the decomposition of the combined electricities goes on with facility, will be much more readily and more vigorously attracted than the other. This one will not begin to be attracted till after a certain time, when the decomposition is finally effected on its surface in spite of the resistance which its substance opposes to the motion of electricity; and, in like manner, when once the decomposition has taken place on this ball, its electrical state subsists even after we withdraw the electrified body. The first ball, although gilt, contracts also in this manner a permanent electricity, because the resin of which we suppose it composed, impregnates itself with the electricity developed at its surface; and both of them are favoured in this respect by the contact of the air, which, under the influence of the electrified tube, tends, above all, to take away from them that part of their combined electricities which is repelled by this body; while it has less effect on that of which the repulsive force is disguised by the tube's attraction. Hence we observe, in general, that insulated bodies which have been for some time under the influence of an electrified body come, at last, to have an excess of electricity of the opposite kind, and of which the effects become manifest when we again withdraw them from the influence of this body.

As the results to which we have now arrived are of continual use in the developement and connection of electrical phenomena, it is necessary to reduce them to a kind of theorem, which we shall enunciate in the following manner:

When a conducting and insulated body B, in its natural state, is placed near another body A, electrified and insulated, the electricity distributed over the surface of A acts, by influence, on the two combined electricities of B, decomposes a quantity proportional to the intensity of its action, and resolves it into its two constituent principles. Of the two electricities thus liberated, it repels that of the same and attracts that of a different name with itself. The first diffuses itself over that part of the surface of B which is farthest from A, and the second over that which is nearest. Both being now at liberty, they act in their turn on the free, and even on the combined electricities of A, which, by this re-action, are partly decomposed, and, if A is also a conductor, are separated. This new separation produces a new decomposition of the combined electricity of B, and the same process goes on until the quantities of each principle, liberated upon the two bodies, attain an equilibrium, by a balance of all the attractive and repulsive forces which they exert on one another, in consequence of the similar or contrary nature of each.

Having thus discovered, in general, the attractive and repulsive properties belonging to the two electricities, the vitreous and the resinous,—having discovered their natural state of combination in bodies,—their separation by the influence of a body at a distance, and the general consequences which result from these new properties, we must, according to the philosophical method now adopted in the sciences, endeavour to submit them to calculation; so as to ascertain exactly the detail of the facts, and to anticipate, for example, in regard to each of the electrified bodies which we cause mutually to act on one another, what will be, on any point of its surface, the quantity and the nature of the electricity.

But as we have found that the effects of these mutual influences, such as we have observed them, arise from actions between the electrical principles themselves, it is easy to conceive that we cannot arrive at their cause without determining the nature and the mode of action of these principles; or, what is the same thing *to us*, imagining, according to the phenomena observed, some calculable mode of action which will represent exactly the phenomena, and which can be verified, if not immediately as to its physical existence, at least indirectly, but with certainty, in its consequences.

But if we consider the extreme facility with which the two electricities, the vitreous and the resinous, diffuse themselves in conducting bodies, and advance towards their surfaces where they are retained by the pressure of the air; if we consider the perfect mobility with which these two principles approach and recede from each other, unite themselves, or separate, without losing any of their original properties; it will be obvious, that the most probable idea we can obtain of their nature, is to regard them as fluids of perfect fluidity, whose particles are endowed with attractive and repulsive powers, and which arrange themselves in the bodies where they can move with liberty, in such a manner as to be in equilibrio, by virtue of all the interior and exterior forces which act upon them.

It is easy to see that each of these fluids must possess in itself a cause of repulsion, which tends to separate its particles from each other. For, if we suppose a certain quantity of vitreous or of resinous electricity, introduced into a sphere of metal where its motions are free, we know that it will diffuse itself entirely at the surface, where it will form a stratum of a very small thickness. If we augment the

diameter of the sphere, the electrical stratum will always recede more and more from its centre, diminishing at the same time its thickness. If we at last withdraw altogether the pressure of the air, the electricity will be completely dissipated. These effects indicate with certainty a repulsive action exerted between the electrical particles of the same nature, and all the phenomena in which the combined electricities are separated from each other by influence at a distance, confirm completely this result, and at the same time also demonstrate the existence of a reciprocal attraction between the electricities of a different nature.

We see also from these phenomena that the attractions and repulsions become weaker in proportion as the distance increases; but according to what law? Among all those which can be tried, there is one which represents and reproduces completely all the phenomena; it is that of the inverse ratio of the squares of the distances. Adopting this law then, the constitutions of the two electrical principles will be comprised in the following enunciation: *Each of the two electrical principles is a fluid, whose particles, perfectly moveable, mutually repel each other, and attract those of the other principle, with forces reciprocally as the square of the distance. Also at equal distances the attractive power is equal to the repulsive.* This equality is necessary in order that in a body, in the natural state, the two combined electricities may not exert any action at a distance.

Having thus defined very precisely the characters and the mode of action of the two fluids, we must now explain the mathematical consequences of this definition, in order to compare them with the phenomena, and to see if they are exactly conformable to them. We must endeavour, above all, to find those which, being susceptible of a precise and numerical value, admit of greater rigour in their verification. But these deductions cannot be obtained but by very profound calculations, which require all the resources of analysis; and, even with the aid of these, it is only of late that they have been established in a general and exact manner. It is to M. Poisson that this fine discovery is due. We shall take from his treatise, published in the *Memoirs of the Institute of France* for 1811, the precise results which calculation has made known to him; we shall borrow them as the rigorous deductions of our first definitions; and it will then only remain for us to ascertain if they agree with the facts.

We shall begin with considering a single conducting and insulated body charged with an excess of vitreous or of resinous electricity, and exempt from all external influence. Setting out from the constitution assigned to the two fluids, calculation informs us, that the fluid introduced into this body will diffuse itself entirely on its surface, and will there form a stratum extremely thin. This is confirmed by observations the most minutely exact. Calculation determines also the interior surface of this stratum and its thickness. The exterior surface, bounded by the air, is the same with that of the body. The air is in this case to electricity, as an impenetrable vase of a given form, which contains it in its interior capacity, and resists by its pressure the tendency which it has to escape.

The interior surface is in every case but very little different from the other, the electrical stratum being very thin. But in order that the electrical state of the body may remain permanent, the form of this surface must be such, that the entire stratum exert neither attraction nor repulsion on the points comprised within its cavity. For, if these actions were not reduced to nothing, they would operate upon the combined electricities of the body, would decompose part of them, and the electrical state of the body would therefore change, contrary to the state of permanency which we have supposed. The analytical condition which establishes this property, determines the form and the thickness of the stratum, which may, and, even in general must, be unequal upon the different parts of the surface of the electrified body. (See the *Memoirs of the Institute of France* for 1811.) If the body, for example, has the form of a sphere, the two surfaces of the electrical stratum will be spherical, and will have their centre in the centre of the sphere. The thickness of the stratum then will be everywhere constant, and equal to the difference of their radii. Newton, indeed, has long since demonstrated, that, in the law of the square of the distance, such a stratum exerts no action on the points which are within. (*Princip. Math.* Lib. 1. Prop. LXX.)

If the proposed spheroid is an ellipsoid, the interior surface of the electrical stratum will be also an ellipsoid, concentric and similar; for it can be demonstrated, that an elliptical stratum, of which the surfaces are also concentric and similar, exerts no action on a point situated in its interior. The thickness of the stratum in every point is determined generally by this construction. It hence follows, that this thickness is greatest at the extremity of the greater axis, and least at the extremity of the smaller; and the thicknesses corresponding to the two extremities of the different axes, are to each other as the lengths of these axes, which, as we have seen, is conform to the experiments. In general, the exterior surface of the fluid stratum is given by the surface of the body itself; and the whole problem is reduced to find for the interior surface a form very little different from this, which shall bring to nothing the total action of the stratum on all the points comprised within its cavity.

The electrical stratum thus disposed, acts by attraction and repulsion on the other electrical particles situated beyond its exterior surface, or at this surface itself. It attracts them if they are of a different nature from its own, and if they are of the same nature it repels them. This last case is that of the electrical particles which form the exterior surface of the stratum, each of these being repelled from within outwards, with a force proportional to the thickness of the stratum at that point. The particles situated under the surface, in the thickness of the stratum itself, suffer a similar repulsion, but weaker, as it is only proportional to the thickness which separates them from the interior surface of the stratum, for the particles with which they are enveloped on the side of the exterior surface, according

to the form of the two strata, exert on them no action at all. All these repulsive forces gradually decreasing, and being resisted in their effects by the external air, which opposes the escape of the electrical particles, it is easy to conceive, that there must result a *total pressure* exerted against this air, and tending to drive it off. This pressure is in a ratio compounded of the repulsive force exerted at the surface, and of the thickness of the stratum; or, as the one of these elements is always proportional to the other, we may say that, in every point, the pressure is proportional to the square of the thickness. It may therefore in general be variable on the surface of electrified bodies.

If this pressure is everywhere less than the resistance which the air opposes, the electricity is retained in the *vase* of air, and cannot escape. But if the pressure, in certain points of the surface, comes to exceed the resistance of the air, then the *vase* breaks, and the fluid escapes through the opening. This is what happens towards the extremities of the points, and on the sharp corners of angular bodies. For it can be demonstrated, that at the summit of a cone, for example, the pressure of the electric fluid would become infinite, if the electricity were allowed to accumulate there. At the surface of an elongated ellipsoid of revolution, the pressure does not become infinite at any point; but it will be so much the more considerable at the two poles, as the axis which joins them is greater in relation to the diameter of the equator. According to the theorems already cited, this pressure will be to that which takes place at the equator of the same body, as the square of the axis of the poles is to the square of the axis of the equator; so that, if the ellipsoid is very much elongated, the electric pressure may be very feeble at the equator, while at the poles it will surpass the resistance of the air. Hence, also, when we electrify a metallic bar, which has the form of a very long ellipsoid, the electric fluid runs principally towards its two extremities, and escapes by these points, in consequence of its excess of pressure above the resistance of the air which opposes it. In general, the indefinite increase of the electric pressure in certain points of electrified bodies, furnishes a natural and exact explanation of the faculty which points possess, of dissipating with rapidity into the non-conducting air the electric fluid with which they are charged.

If the nature of the electrified body were such that the electricity could not move freely in it, the excess of pressure, of which we have been speaking, would exert itself against the particles themselves of the body which envelope the electric stratum; or, in general, against those which, either by their affinity, or by any other mode of resistance, would oppose its dissipation.

Having determined, according to the theory, the manner in which electricity disposes itself in a single conducting body, insulated and unaffected by any external influence, let us pass to the more complicated case, where several electrified and conducting bodies act mutually on each other; and as it is necessary to make choice of bodies whose form renders the phenomena accessible to calculation, let us consider two spheres of some conducting substance, both electrified and placed in presence of each other at any distance.

The disposition of electricity in these circumstances, and in all those where several electrified bodies are submitted to their mutual influence, depends on a general principle, evident in itself, and which has the valuable advantage of reducing all these questions to a mathematical condition. The following is its enunciation, which we take from the treatise of M. Poisson.

If several electrified bodies are placed near each other, and if they arrive at a permanent state of electricity, it is necessary in this state that the resulting effect of the actions of the electric strata which cover them, upon any point taken in the interior of these bodies, be nothing. For if this resulting force were not nothing, the combined electricity which exists at the point in question would be decomposed, and the electrical state would change, contrary to the supposition which we have made of its permanency.

This principle, translated into the language of the calculus, furnishes immediately as many equations as we consider bodies, and as there are unknown quantities in the problem. But their resolution often surpasses the powers of analysis. M. Poisson, however, who has so happily discovered the general key of this theory, has at last surmounted all the analytical difficulties, for the case of two spheres placed in contact or near to each other, and primitively charged with any quantities of electricity. The formulæ to which he has arrived afford a great number of results which can be verified by experiment, and which form so many severe tests of the justness of the theory. Besides the interest which such verification must always present, we will obtain in them the farther advantage, of fixing our ideas with precision on the most delicate phenomena which electricity produces.

Suppose, *first*, the two spheres in contact, and charged with either electricity, vitreous or resinous; calculation shows that there is no free electricity at the point of contact. From thence the thickness of the electric stratum goes on increasing on each of the spheres, according to a law which depends on the relation of their radii, but it attains always its maximum on the opposite side, on the line of the two centres. If we separate the two spheres, each of them preserves the same quantity of electricity which it has attained during the contact, and these quantities have to each other a relation which the calculation assigns according to the proportion of the radii.

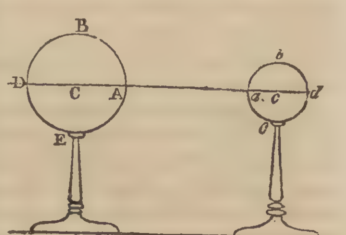
The verification of these results is effected with the greatest facility, by means of the small proof plane, and by the general method of alternate contacts explained above. In this manner the indications of the theory are found to be confirmed by experiment in their minutest details; that is to say, that, on introducing into the theoretical formulæ the diameters of the spheres on which we operate, or only the relations of these diameters, the calculus shows in advance, and as exactly even as the observations themselves, the law of the distribution of

electricity over the two spheres, as well as the proportion of its intensity on each. There is no occasion, even for this purpose, of new experiments; for we may take those which have been already made by Coulomb, and have for a long time been published in the *Transactions of the Academy of Sciences;* and, accordingly, it is with these previous results, whose priority, indeed, gives them all the authenticity of an incontestible fact, that M. Poissôn has compared the numbers given by his theory.

The case of contact being thus completely analysed, let us examine what takes place when the two spheres separated from their contact are removed to a certain distance from each other.

In this case, a very remarkable phenomenon, discovered by Coulomb, is developed, and of which that philosopher determined the measure by his electric balance. We have seen that, during the contact, the electricity is the same on both the spheres. To fix our ideas, suppose it to be the *vitreous*. As yet its intensity is nothing, as we have seen, at the point of contact; but the instant we separate the two spheres, if their dimensions are unequal, this state of things ceases. A part of the combined electricities of the *small sphere* is decomposed, and what is of a contrary nature to that of the large sphere, namely, the resinous in our example, appears in, and near the point where the contact took place. This effect diminishes in proportion as we remove the spheres from each other, and vanishes altogether at a certain distance, which depends on the proportion of their radii. At that distance, the point of the small sphere, where the contact was made, returns to the state in which it was during the contact itself, that is, it has no more any species of electricity. From this position, if we still increase the distance, the electricity remains of the same nature over all the extent of the small sphere, and of the same nature also as it was during the contact. These changes are *always* peculiar to the smallest of the two spheres, whatever be the quantity of electricity which has been previously communicated to either. As to the larger of the two spheres, the electricity is always, and everywhere, of the same nature as at the moment of contact.

To observe these phenomena, we place the two spheres upon solid supports of some insulating substance, and of such a magnitude that their centres may be in a horizontal plane, as represented in the figure. (5.) After having placed them in contact, and electrified them together, we remove them to a small distance, A *a*, from each other. We then carry the proof plane first to A upon the large sphere, to the point where the contact was made; and by trying, not with the electrical balance, but with a very sensible electroscope, the electricity which it carries off, we observe that it is always of the same nature with that upon the rest of the surface ABDE. Making then the same trial at the corresponding point *a*, we find that the electricity in this point is, *first*, of a nature contrary to that of the large sphere; then nothing when the distance becomes a little greater; then of the same nature when the distance becomes still greater; and in this manner, by gradually augmenting the distance, we see the phenomena pass through all the periods which have been already pointed out by the theory. These trials must be all made with the most sensible electroscope, in order to perceive the feeblest signs of either electricity.



In one of Coulomb's experiments, the large globe was twelve inches in diameter, and the small one eight. As long as the distance A *a* was less than an inch, the point *a* gave signs of a contrary electricity to that of the large globe. When the distance became equal to an inch, the electricity of this point became equal to nothing, as at the instant of contact; and, lastly, at every distance beyond this, it became of the same nature with that of the other sphere. The large globe remaining the same as in the preceding experiment, Coulomb gave to the small globe a diameter of only four inches; then the two electricities continued of an opposite nature to the distance of two inches. When this diameter was only two inches and under, the opposition was kept up to the distance of two inches five lines, but no farther.

The comparison of these experiments shows, that the distance A *a*, where the opposition of the electricity ceases, diminishes in proportion as the two globes approach to an equality, and becomes nothing when they become equal. This is a circumstance which is also confirmed by the theory, which equally indicates all the other details of the phenomenon, the relation between the radii of the two globes being given.

That these experiments may succeed well, the air must be very dry; else the electricity of the large globe, escaping through the air, will tend directly to neutralize the weak electricity of the opposite kind, which is developed at the point *a* of the little globe, and the phenomena will become much less sensible, if not entirely disguised.

We have hitherto supposed the two globes to have been brought into contact before being submitted to their mutual influence. This condition establishes between the quantities of electricity, which they possess, a relation that limits the generality of which the problem is susceptible, and to embrace it entirely, we must consider two spheres charged, in any proportions whatever, with electricity of the same or of a different nature; and that they gradually approach each other until they come into contact.

Here the analysis of M. Poisson has anticipated the results of experiment. It is from thence that we shall draw the details into which we are to enter; and which, if they should come one day to be observed, will furnish the severest test to which this analysis can be submitted.

When two electrified spheres are made gradually to approach each other, and when there does not exist between the species and the quantities of electricity which they possess, the particular relation which would be established by their contact, the

thickness of the electric stratum at the points nearest each other, on the two surfaces, becomes greater and greater, and increases indefinitely as their distance diminishes. It is the same with the pressure exerted by the electricity against the mass of air intercepted between the two spheres; since the pressure, as we have mentioned above, is always proportional to the square of the thickness of the electric strata. It must at last then overcome the resistance of the air, and the fluid, in escaping under the form of a spark or otherwise, must pass, previous to the contact, from the one surface to the other. The fluid thus accumulated, before the spark takes place, is of a different nature, and of nearly equal intensity on each of the spheres. If they are electrified, the one *vitreously* and the other *resinously*, it is vitreous in the first and resinous in the second; but when they are both electrified in the same manner, vitreously for example, there arises a decomposition of the combined electricity upon the sphere which contains less of the vitreous fluid than it would have in the case of contact; the resinous electricity, resulting from this decomposition, flows towards the point where the spark is preparing, and, on the contrary, the other sphere, which contains more vitreous electricity than it would have after the contact, remains vitreous over its whole extent.

The phenomena are no more the same after the two spheres have been brought in contact together, and are then removed, however little, from each other. The ratio which then exists between the total quantities of electricity with which they are charged, causes to disappear in the expression of the thickness, the term which before became infinitely great for a distance infinitely small, and no spark takes place. The electricity of the points nearest each other upon the two spheres is then very feeble, for very small distances, according to a law which calculation determines, and its intensity is nearly the same on both spheres; but when they are unequal, this electricity is vitreous on the one, resinous on the other; and it is *always upon the smallest* that it becomes of a nature contrary to the total electricity, which is conformable to the observations related above.

In general, all the varieties of these phenomena depend on the relation which we establish between the radii of the two spheres, and also between the quantities of electricity with which they are charged. We may even determine these proportions in such a manner, that, at a certain distance, the thickness of the electric stratum on the small sphere may be almost constant, so that this sphere may remain near the other, almost as if it were not exposed to any action, not from the weakness of the electricity on the other sphere, but in consequence of a sort of equilibrium which is then established between its action upon the smallest, and the re-action of this upon itself. In this case, the electricity diffused over the large sphere is vitreous in certain parts, resinous in others, and its thickness in different points presents very considerable variations. M. Poisson has determined the proportions of volume and of electric charge necessary to produce these phenomena; and, in this respect, as we have formerly observed, his analysis has anticipated the observations.

To complete the case of two electrified spheres placed in presence of each other, M. Poisson has calculated the changes which the greater or less distance produces on the state of the points most distant from those where the contact takes place. In this respect he has found, that, in proportion as the two spheres approach each other, the thicknesses of the electric stratum in these points tend more and more towards the values which they would have at the instant of contact. As they arrive at this limit, however, but very slowly, it hence follows, that even at very small distances, they differ yet much from what they would be if the contact or the spark actually took place. Hence we conclude also, that the spark, when it takes place at a sensible distance, changes suddenly the distribution of the electricity over the whole extent of the two surfaces, from the point where it is produced even to that which is diametrically opposite. This re-action is easily verified by experiment; we have only to fix, at certain distances from each other, along an insulated conductor, couples of linen threads, with pith balls suspended to them, and to communicate to this conductor a certain quantity of electricity, by which the threads may be made to diverge; if we then draw successively several sparks by the contact of an insulated sphere, whose volume is not too small, all the threads will be observed to be disturbed, and shaken in a manner by each explosion, in whatever part of the conductor it is produced.

For the particular case in which the two electrified spheres are removed to a great distance from each other, in relation to the radius of any one of them, M. Poisson has discovered formulæ which express in a very simple manner the thickness of the electric stratum, in any point of their surfaces. We shall here state these formulæ, as they enable us to explain distinctly *why* conducting bodies, when they are electrified, *seem* to attract or repel each other, although, from the manner in which electricity is distributed among them, and from its mobility in their interior, we cannot suppose that these phenomena indicate any sensible affinity which it has for their substance. Let r, r' represent the radii of the two spheres; call e, e' the thicknesses of the strata which the quantities of electricity they possess would form upon their surfaces if they were left to themselves, and exempt from all external influence; call a the distance of their centres, and place them so far from each other that the radius r' of one of them be very small compared with a, and with $a - r$. Lastly, let u, u' denote the angles formed with the distance a, by the radii drawn from the centre of each sphere to any point on their surfaces; then the thicknesses E, E' of the electric stratum in these points will be expressed approximately by the following formulæ.

$$E = e + \frac{e' r'^2}{ar} - \frac{e' r'^2 (a^2 - r^2)}{r (a^2 - 2ar \cos. u + r^2)^{\frac{3}{2}}}$$

$$E' = e' - \frac{3 e r^2}{a^2} \cos. u' + \frac{5 e r^2 r'}{2 a^3} (1 - 3 \cos.^2 u')$$

Here, as in the experiments of Coulomb, the angles u, u' are reckoned from the points A and a

(fig. 5), in which the surfaces of the two spheres would touch each other, if we brought them to the point of contact. The difference of symmetry in these expressions is owing to this, that the approximation from which they arise supposes the radius r', of the second, very small compared with the distance $a-r$, which separates its centre from the surface of the other.

If it is required, for example, from these formulæ to determine the state of an insulated, but not electrified sphere, which we present to the influence of another sphere charged with a certain quantity of electricity, we have only to suppose e' nothing in the equation of the second sphere, and it will then become

$$E' = \frac{-3er^2}{a^2}\left[\cos. u' + (3\cos.^2 u' - 1)\frac{5r'}{6a}\right]$$

At the point a, on the line Aa, between the two centres, the angle u' is nothing. In this point then we have $\cos. u' = 1$: and $E' = -\frac{3er^2}{a^2}\left(1+\frac{5r'}{3a}\right)$

The thickness E', then, has always a contrary sign to that of e, that is to say, that the electricity on this point, in the sphere of which the radius is r', is of a nature contrary to that which covers the sphere of which the radius is r.

At the point d, diametrically opposite to the preceding, the angle u' is equal to 180^0, which gives

$\cos. u' = -1$; and $E' = +\frac{3er^2}{a^2}\left(1-\frac{5r'}{3a}\right)$

This value of E' has always the same sign with that of e; for the factor $\frac{5r'}{3a}$ is a fraction far smaller than unity, since the distance a is supposed very great, compared with the radius r'; then the electric stratum will be in this point of the same nature as upon the other sphere.

Thus we see arising out of the theory the important result which we have until now only established by experiment, that while a sphere c, not electrified, is placed in presence of another sphere C, electrified vitreously, for example, the combined electricities of c are partly decomposed; the resinous electricity that results flowing towards the part of c which is nearest to C, and the vitreous electricity towards the part which is farthest from it.

The thicknesses of the stratum in these two points are to each other in the ratio of

$$1+\frac{5r'}{3a} \text{ to } 1-\frac{5r'}{3a};$$

they are nearly equal, then, since a is supposed very great in relation to r'.

Hence it may be conceived that there must be upon the sphere c a series of points, in which the thickness of the electric stratum is nothing, and which form a curve of separation between the two fluids. The *locus* of these points will be found by putting the general expression of the thickness E' equal to zero, which gives the condition

$$0 = \cos. u' + (3\cos.^2 u' - 1)\frac{5r'}{6a}.$$

If the distance a were altogether infinite, compared with the radius r', the second member of this equation would be reduced to $\cos. u'$; consequently, this cosine would be 0, which would give $u' = 90^0$. The line of separation of the two fluids would then be the circumference of the great circle, of which the plane is perpendicular to the line of the centres.

But if a is not infinite, it is at least very great relatively to r'. Thus, the factor $\frac{5r'}{6a}$ will still be a very small fraction, and the true value of $\cos. u'$ will be equally so. We may, therefore, in calculating, neglect the product of $\frac{5r'}{6a}$ by $\cos.^2 u'$, compared with the product of this same quantity by unity. With this modification the equation resolves itself and gives

$$\text{Cos.} u' = \frac{5r'}{6a}$$

In this case the line of separation of the two fluids is still a circle whose plane is perpendicular to the line of the centres; but the distance of this plane from the centre of the sphere, in place of being nothing, is equal to $r' \cos. u'$ or $\frac{5r'^2}{6a}$, this distance being taken from c to a, towards the electrified sphere C.

In considering only the degree of the equation which determines generally $\cos. u'$, there would seem to be two values of this cosine which would satisfy the conditions of our problem; but it will clearly appear, that one of those roots should necessarily be greater than unity, and, consequently, will not have here any real application, as it would correspond to an arc u', which is imaginary.

When we now consider how various, how delicate, and how detached from each other, are the phenomena this theory embraces; with what exactness, also, it represents them, and follows, in a manner, all the windings of experiment, we must be convinced that it is one of the best established in physics, and that it bestows on the real existence of the two electric fluids the highest degree of probability, if not an absolute certainty. But what is not less valuable for science, it teaches us to fix, by exact definitions, the true meaning which we must attach to certain elements of the electrical phenomena, which are too often vaguely enunciated, or even confounded, with others; although the knowledge of each of them, individually, is indispensable to form a correct and general idea of the phenomena.

The first of these elements is the *species*, vitreous or resinous, of the electricity which exists at the surface of an electrified body, and at every point of this surface. This is determined by touching it with the proof plane, and presenting this to the needle of the electroscope, already charged with a known species of electricity.

The second element is the *quantity* of this electricity accumulated on every point, or, what comes to the same thing, *the thickness of the electric stratum.* This we still measure by touching the body with the

proof plane, and communicating the electricity acquired by this contact to the fixed ball of the electric balance, the moveable one having been previously charged with electricity of the same nature. The force of torsion necessary to balance the electric reaction communicated by the plane to the fixed ball, is at equal distances proportional to the quantity of electricity which it possesses, or, what is the same thing, to the thickness of the electric stratum on the element of the surface which it has touched.

The third element which it is of importance to consider in the phenomena, is the *attractive or repulsive action* exerted by each element of the electric stratum upon a particle of the fluid situated at its exterior surface or beyond this surface. This attraction or repulsion is directly proportional to the thickness of the electric stratum on the superficial element which attracts or repels, and is inversely proportional to the square of the distance which separates this element from the point attracted or repelled.

In fine, the last element to be considered, and which is a consequence of the preceding ones, is the *pressure* which the electricity exerts against the external air in each point of the surface of the electrified body. The intensity of this pressure is proportional to the square of the thickness of the electric stratum.

By adhering strictly to these denominations, there will be no risk of falling into error from vague considerations; and if we also keep in mind the developement of electricity by influence at a distance, we shall then find no difficulty in explaining all the electric phenomena.

To place this truth in its full light, we shall apply it to some general phenomena which, viewed in this manner, can be conceived with perfect clearness, but which, otherwise, do not admit but of vague and embarrassed explications. These phenomena consist in the motions which electrified bodies assume, or tend to assume, when they are placed in presence of each other, and in which they appear as if they really acted upon each other by attraction or by repulsion. But it is extremely difficult to conceive the cause of these movements, when we consider that, according to the experiments, the attraction and repulsion are only exerted between the electric principles themselves, without the material substance of the body, provided it be a conductor, having any influence on their distribution or their displacement. We cannot hence admit, that the particles of the electric principles, whatever they may be, really attract or repel the material particles of the bodies. It is absolutely necessary, therefore, that the attractive and repulsive actions of these principles, whatever they are, be transmitted indirectly to the material bodies, by some mechanism which it is of extreme importance to discover, as it is the true key to these phenomena. But we will see that this mechanism consists in the reaction produced by the resistance which the air and non-conducting bodies in general oppose to the passage of electricity.

For the sake of greater simplicity, we may first confine ourselves to the consideration of two electrified spheres A and B; the one A fixed, the other B moveable. Three cases may arise which it is necessary to discuss separately.

1. A and B non-conductors.
2. A, a non-conductor, B, a conductor.
3. A, a conductor, and B, a conductor.

In the first case, the electric particles are fixed upon the bodies A and B, by the unknown force which produces the non-conductibility. Unable to quit these bodies they divide with them the motions which their reciprocal action tends to impress upon themselves.

The forces then which may produce the motion of B, are, 1. The mutual attraction or repulsion of the fluid of A upon the fluid of B. 2. The repulsion of the fluid of B on itself. But it is demonstrated in mechanics, that the mutual attractions and repulsions exerted by the particles of a system of bodies on each other, cannot impress any motion on its centre of gravity; the effects of this internal action then destroy themselves upon each of the spheres; there cannot result from it any motion of the one towards the other; and the first kind of force, therefore, is the only one to which we need pay any attention. If the electricity is distributed uniformly over every sphere, each of them attracts or repels the other as if its whole electric mass were collected in its centre. Thus, if we call a the distance of their centres, r,r' their radii, e,e' the thicknesses of the electric strata formed upon their surfaces by the quantities of electricity introduced into them, the electric mass of each of them will be $4\pi r^2 e$, $4\pi r^2 e'$, π being the semi-circumference of which the radius is equal to unity, and the attractive or repulsive force will be expressed by $\frac{16\pi^2 K r^2 r'^2 ee'}{a^2}$, K being a coefficient which expresses the intensity of the force when the quantities a, e, e', are each equal to the unity of their species. This force transmits itself directly to the two spheres, in consequence of the adhesion by which they retain the electric particles. We see, from this expression, that the force must become nothing, if e or e' be nothing, that is, if the one of the two spheres be not primitively charged with electricity. During the motion it suffers no alteration but what arises from the distance, because the two spheres being supposed of a perfectly non-conducting substance, their reciprocal action produces upon them no new developement of electricity.

In the second case, where A is a non-conductor, and B a conductor, the sphere B, suffers a decomposition of its natural electricities by the influence of A. The opposite electricities which result from this decomposition unite with the new quantity which has been introduced, and dispose themselves together according to the laws of the electric equilibrium. Here the motion of B towards A may be regarded under two points of view.

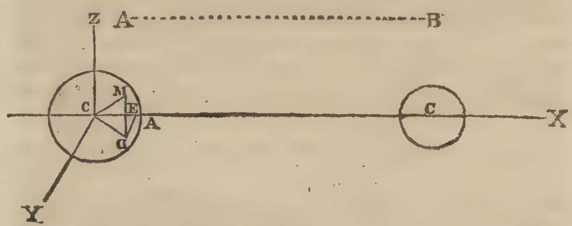
Suppose, first, that without disturbing the electric equilibrium of B, we extend over its surface an insulating stratum, solid, without weight, and which may remain invariably attached to it. The electri-

city of B, unable to escape, will press as it were against this stratum, and, by this means, transmit to the particles of the body the forces by which it is urged. The forces which then act upon the system will be, 1. The mutual attraction or repulsion of the fluid of A on the fluid of B. 2. The repulsion of the fluid of B upon itself, a repulsion, however, which cannot produce any motion upon the centre of gravity of B. 3. The pressure of the fluid of B upon the insulating envelope, a pressure, again, which being exactly counterbalanced by the reaction of this coating, produces still no motion whatever. The first force, then, is still the only one to which we need pay any attention.

When the distance a, of the two spheres is very great relatively to the radii of their surfaces, the decomposed electricities of B, as we have seen at page 85, are distributed almost equally over the two hemispheres situated on the side of A, and on the opposite. In that case the actions which they suffer on the part of A are nearly equal, and destroy each other; all the force then is produced by the quantities of external electricity, $4\pi r^2 e$, $4\pi r'^2 e'$ introduced into the two spheres, which, acting as if they were wholly collected in their centres, the force becomes still $\frac{16\pi^2 K r^2 r'^2 ee'}{a^2}$.

When the two spheres are very far from each other, the coefficient K may be considered as constant, and the attractive or repulsive force varies not but in consequence of a change in the distance a. But this is only an approximation; for, to consider the matter rigorously, the electrical state of the conducting sphere B, varies in proportion as it approaches A, on account of the separation which this produces in its natural electricities. Hence also the reciprocal action of the two spheres ought to vary in a very complicated manner, and it is probably to this that we must ascribe the error which appears in the experiments of Coulomb, at very small distances, when calculated by the simple law of the square of the distance.

The supposition of an insulating envelope without weight, serves here merely to *connect* the electric fluid with the material particles of the body B, and we may always regard as such the little stratum of air with which bodies are ordinarily enveloped, and which adheres to their surfaces. Yet the same result may be obtained without the aid of this intermediary; but, in that case, we must consider the *pressures* produced upon the air by the electricities which exist at liberty in B. These electricities, in effect, as well those that have been introduced, as those that are decomposed on it, move towards the surface of B, where the air stops them by its pressure, and prevents their escape; they dispose themselves then *under* this surface, as their mutual action and the influence of the body A require, resting, for this purpose, against the air, which prevents them from expanding. But, reciprocally, they press this air from within outwards, and tend to fly off with a force proportional to the square of the thickness of the electric stratum in every point. Decompose these pressures in the direction of three rectangular axes of the co-ordinates $x\ y\ z$, the one x being in the direction of the straight line Cc (fig. 6),



which joins the centres of the two spheres, and add together all the partial sums; it will then be found, as we shall show presently, that, in the direction of the co-ordinates y and z, they amount to nothing, and there only remains, therefore, a single resulting force, directed in the straight line Cc, that is, towards the centre of the sphere A. When the spheres are very distant from each other, compared with the radii of their surfaces, the decomposed electricities of B press the external air, in opposite directions, with a force nearly equal, and their effects destroy each other almost exactly. There only remains, then, the effect of the quantities e, e' introduced into the two spheres, and from this there results an excess of pressure in the direction of the lines of the centres, and expressed by $\frac{Kee'}{a^2}$, K being a constant quantity for the two spheres, that is, exactly the same as was obtained by the other method. It is evident, besides, that this expression is subject to the same limitation, since the pressures produced by the electric stratum against the external air, ought to vary with the quantity of natural electricity decomposed on B by the influence of A, in proportion as the two spheres approach each other.

The third case, in which A and B are both conductors, is resolved exactly upon the same principles, either by imagining the two electrified surfaces covered with an insulating envelope, and calculating the reciprocal actions of the two fluids which are transmitted by means of this cover to the material particles; or in considering the pressures produced on the external air by the two electric strata, and calculating the excess of these pressures in the direction of the line which joins the two centres; only, in this case, the attractive or repulsive force of these two spheres will vary in proportion as they approach each other, not only by the difference which thence arises in the intensity of the electric action, but still farther by the decomposition of the natural electricities which will be going on in the two conducting bodies A and B.

To render the mathematical exactness of these considerations evident, we shall, for the preceding case, go through the calculation of the pressures exerted against the air by the quantities of electricity introduced or developed on the two spheres. This will have, besides, the advantage of giving a new application to the formula stated at p. 84. For this purpose take, first, on the sphere A, fig. 6, any point

whatever which we may denote by M. The pressure exerted at this point against the air depends on the thickness of the electric stratum there. To know this, we must put the particular value of the angle u, which corresponds to the point M, in the general expression of E given at page 84, and multiply the square of this thickness by a constant coefficient k, which will disappear of itself, when we take the relations of the pressures among each other at different points. In this manner, the pressure for any point of either sphere calculated for the unity of the surface, will be represented by kE^2 upon the first, and kE'^2 upon the second, E, E′ being taken from the formulæ stated in p. 84. We shall now develope, successively, these two expressions. In the first place, as the pressure kE^2 varies from one point to another with the thickness of the electric stratum, we cannot suppose it the same, but in a very small space all round the point M, a space which must be considered as a superficial element of the sphere, and which we shall call ω; thus the expression KE^2 being calculated for the unity of surface, the pressure upon the small superficial element ω will be $K\omega E^2$. This pressure acts perpendicularly to the spherical surface A, in the direction of the radius CM; decompose it then into three others, parallel to three axes of the rectangular co-ordinates x, y, z, which have their origin at the centre C; the first, x, being in the direction of the straight line, Cc, which joins the centres of the spheres, and the two others perpendicular to this line. To effect this decomposition, we must multiply the normal pressure KE^2 by the cosines of the angles which the radius CM forms with the co-ordinates x, y, z; that is, by $\frac{x}{r}$, $\frac{y}{r}$, $\frac{z}{r}$, since, in the formula of p. 84, we have represented by r the value of the radius CM of the sphere A. We will thus have the three following component parts

parallel to the co-ordinates x; $K\frac{x}{r}\omega E^2$

parallel to the co-ordinates y; $K\frac{y}{r}\omega E^2$

parallel to the co-ordinates z; $K\frac{z}{r}\omega E^2$

But we must observe, first, that it is absolutely of no use paying any attention to the two last, because the efforts which each of them makes, on the whole extent of the surface, mutually destroy each other, on account of the symmetrical disposition of the electricity relatively to the axis of the co-ordinates x, which joins the two centres. If we consider, in effect, the force, for example, $K\frac{z}{r}\omega E^2$ for the point M, situated in the figure under the plane of the co-ordinates xy; we shall find, above this plane, another point M′ situated quite similarly, and of which the co-ordinates x, y, z, will consequently be the same, with this only difference, that z will there be negative, on account of its opposite situation relative to the origin of the co-ordinates. For this second point, the element ω, and the pressure KE^2, will be also absolutely the same; ω on account of the symmetry of the surface of the sphere A; E^2 on account of the symmetrical disposition of the electricity round the axis of the co-ordinates x, which joins the centres of the two spheres A and B; but the component force which proceeds parallel to the co-ordinates z, will be $-K\frac{z}{r}\omega E^2$, on account of the negative sign of z; this force and its analogous one, $+K\frac{z}{r}\omega E^2$ being equal, and in opposite directions, will mutually destroy each other, and a similar equilibrium will be equally obtained, in this kind of pressure, for all the other couples of points M, M′, which correspond on the two sides of the plane of xy.

A similar process of reasoning will prove that the forces $K\frac{y}{r}\omega E^2$ will destroy each other two and two, upon corresponding points, taken on the two sides of the plane of xz, and of which the co-ordinates will be $+x, +y, +z$ for the one, and $+x, -y, +z$ for the other.

It remains, then, to consider the components of the pressures, taken parallel to the co-ordinates x; that is, parallel to the straight line which joins the centres Cc, of the two spheres; and, indeed, from the symmetrical disposition of electricity round this straight line, it is evident that it cannot have any motion but in this single direction; and, consequently, these components alone must produce the tendency of the two spheres towards each other.

To obtain, in the simplest manner, the sum of all these components, it must be remarked, that their general expression $K\frac{x}{r}\omega E^2$ contains no variable but x; for cos. u, which enters into the value of E^2 is equal to $\frac{x}{r}$; it hence follows, that their intensities are equal in the points relatively to which the co-ordinate x is the same, and which are consequently situated upon one small circle, parallel to the plane of the co-ordinates y, z. Besides, as all these points are equally distant from the line of the centres, it is clear that the total result of the equal forces which are applied to them will be in the direction of this line; consequently this will also be the direction of the general result of all the efforts of this kind exerted upon the whole surface of the sphere A.

To obtain now, easily, the sum of all these forces, parallel to the line of the centres, which is here that of the co-ordinates x, let us begin by joining together the values of x which are equal and contrary; for the thicknesses E, of the electric stratum on the two hemispheres of A being almost equal, from the supposition that the two spheres are very distant, the pressures corresponding to opposite values $+x$ and $-x$, must be almost equal also; and, as the components which they give parallel to the co-ordinates x are in a contrary direction, their sum must be reduced to a

Electricity. very small quantity. To introduce this circumstance, call $E_{,}$ what E becomes when we change $+x$ into $-x$; then the expressions of the corresponding components parallel to the co-ordinates x will be,

On the side of the positive co-ordinates x,	$+K\frac{x}{r}\omega E^2$	Tending to move the air in the direction AB
On the side of the negative co-ordinates $-x$,	$-K\frac{x}{r}\omega E_{,}^2$	Tending to move the air in the direction BA

We preserve the superficial element ω always of the same value, because it is exactly alike in the two cases, on account of the symmetrical form of the sphere on the two sides of the plane of the co-ordinates yz; adding these two components to each other with their actual sign, their sum will express the element of the total resulting force which tends to carry the air in the direction AB. This, then, will be $K\frac{x}{r}\omega(E^2-E_{,}^2)$, or, what is the same thing,

$$K\frac{x}{r}\omega(E+E_{,})(E-E_{,})$$

But, from the formula of p. 84, we have generally

$$E=e+\frac{e'r'^2}{ar}-\frac{e'r'^2(a^2-r^2)}{r(a^2-2ar\cos.u+r^2)^{\frac{3}{2}}}$$

To change $+x$ into $-x$, $+\cos.u$ must become $-\cos.u$, because $\cos.u=\frac{x}{r}$; for this second case, then, we shall have

$$E_{,}=e+\frac{e'r'^2}{ar}-\frac{e'r'^2(a^2-r^2)}{r(a^2+2ar\cos.u+r^2)^{\frac{3}{2}}}$$

consequently, by subtracting these equations from each other, we have

$$E-E_{,}=\frac{e'r'^2(a^2-r^2)}{r}\left\{\frac{1}{(a^2+2ar\cos.u+r^2)^{\frac{3}{2}}}-\frac{1}{(a^2-2ar\cos.u+r^2)^{\frac{3}{2}}}\right\}$$

or, what is the same thing, and is better adapted for approximations,

$$E-E_{,}=\frac{e'r'^2\left(1-\frac{r^2}{a^2}\right)}{ar}\left\{\frac{1}{\left(1+\frac{2r}{a}\cos.u+\frac{r^2}{a^2}\right)^{\frac{3}{2}}}-\frac{1}{\left(1-\frac{2r}{a}\cos.u+\frac{r^2}{a^2}\right)^{\frac{3}{2}}}\right\}$$

Since we suppose the two spheres very distant from each other, compared with the magnitude of their radii, $\frac{r}{a}$ will be a very small fraction; hence we may develope this expression for E—E into a converging series of the ascending powers of $\frac{r}{a}$, this will be effected by the binomial theorem; and taking only the first power of $\frac{r}{a}$, which, in the case we are considering, will contain an infinitely great proportion of the total result, compared with the other powers, it will become

$$E-E_{,}=\frac{e'r'^2}{ar}\left\{1-\frac{3r}{a}\cos.u-1-\frac{3r}{a}\cos.u\right\}$$

or by reduction $E-E_{,}=\frac{-6r'^2e'\cos.u.}{a^2}$

This value of $E-E_{,}$ must now be multiplied by $E+E_{,}$ to form the factor $E^2-E_{,}^2$ which enters into the expression of the total resulting force; but since $E-E_{,}$ is already of the order $\frac{r'^2}{a^2}$ it is evident that, in $E+E_{,}$ we must confine ourselves to the terms which are not divided by a; this limitation reduces the value of $E+E_{,}$ to $2e$, and employing this to multiply $E-E_{,}$ there results

$$E^2-E_{,}^2=\frac{-12ee'r'^2}{a^2}\cos.u.$$

It only remains to substitute this value in the expression of the resulting force, parallel to the co-ordinates x, which we have found equal to $\frac{Kx\omega}{r}(E^2-E_{,}^2)$ for the superficial element ω; and by putting for $\frac{x}{r}$ its value $\cos.u$, the expression will become

$$\frac{-12Kee'r'^2}{a^2}\omega\cos.^2u.$$

Each of these partial results is proportional to the superficial element ω, and to the square of the cosine of the angle, which these elements form with the axis of the co-ordinates x. But, if we compare them together upon different spheres, this angle will always be expressed by the same values; for the equal values of u, however, the superficial element ω will vary in magnitude proportionally to the square of the radius r of the sphere. Consequently, the sum of all the values of the factor $\omega\cos.^2u$, extended to every sphere, will only vary from each other in the ratio of the square r^2; it may be represented then by $K'r^2$, K' being a constant and numerical coefficient which may be found, and which, in reality, is found by the processes of the integral calculus. Supposing it known then, the total result of the pressures parallel to the co-ordinates x will be $\frac{-12KK'ee'r^2r'^2}{a^2}$ (1).

It will be directly proportional then to the quantities $4\pi^2r^2e$, $4\pi r'^2e'$ of external electricity which they possess, and inversely proportional to the square of the distance of the two centres When the quantities of electricity given to the two spheres are of the same nature, whether vitreous or resinous, the values of e and of e' must be considered as having the same sign. In that case the expression (1) is negative. that is to say, according to what has been previously admitted, that, in this case, the air which surrounds the sphere

Electricity. A, is more pressed in the direction BA, than in the direction AB. It will not then press equally the sphere A, as it did before it was electrified; it will press it less on the side which is most distant from the other sphere, since it is in that direction that the electric reaction is the strongest. Consequently, if the sphere A is at liberty to move, and deprived of its weight, or if its weight be sustained by a thread of suspension, it will put itself in motion from the side where the atmospheric pressure has become the weakest, that is to say, that it will recede from the other sphere B.

The contrary would happen, according to our formula, if the quantities e,e' of electricity introduced into the two spheres were of a different nature, for then it would be necessary in the calculation to give to them different signs. The formula (1), which represents the total result of the pressures exerted against the air parallel to the line of the centres, will then become positive, that is to say, according to what has been already agreed on, the external air will be more pressed in the direction AB, than in that of BA; the sphere A will move then in the direction in which the external pressure will have become the weakest, that is towards the sphere B, agreeably to observation.

We have hitherto only considered the effect of the pressures round the sphere A, but the same reasonings and calculations will apply to the other sphere; only we must then employ, instead of E and $E_{\prime}$ the expressions of the electric strata which correspond to them, and which we have seen to be

$$E' = e' - \frac{3er^2}{a^2}\cos. u' + \frac{5er^2r'}{2a^3}(1 - 3\cos.^2 u').$$

It might be shown for this case as well as for the other, that there cannot be any inequality of pressure but in the direction of the co-ordinates x; then comparing the points of the surface which correspond to the two sides of the plane of the co-ordinates $y\,z$, we shall find that the element of the resulting force of the pressures parallel to the co-ordinates x, is in general expressed by $\frac{Kx\omega'}{r'}(E'^2 - E_{\prime}'^2)$ in representing by $E_{\prime}'$ what E' becomes when we change $+x$ into $-x$, that is to say, $+\cos. u'$ into $-\cos. u'$, the angle u' being here reckoned from the point a, situated on the side of A upon the line of the centres. By next considering the spheres as very distant we will obtain in the same manner the value of $E' - E_{\prime}'$. Approximating no farther than the first power of $\frac{r'}{a}$, this will give $E' - E_{\prime}' = \frac{-6er^2}{a^2}\cos. u'$. We have then only to take $E + E_{\prime}' = 2e'$, and putting these values in the expressions of the partial resulting force, it will become $\frac{-12Kee'r^2\omega'\cos.^2 u'}{a^2}$. It may be demonstrated as above, that the sum of the factors $\omega'\cos.^2 u'$ will be proportional to the square of the radius of the sphere B, and may besides be represented by $K'r'^2$; K' being the same numerical coefficient we have already employed. For the total resulting force then, the expression will finally become $\frac{-12KK'ee'r^2r'^2}{a^2}$, Electricity.

that is, exactly the same which we have obtained for the other sphere, which ought to be the case, since in these sort of phenomena action and reaction are always equal. Here, as in the example immediately above, the positive sign of the expression will signify that the resulting force of the pressures exerted against the air round the sphere B, is directed towards the other sphere, and the negative sign will signify that this resulting force is directed the opposite way. The first case will take place when the electric charges ee' are of a contrary nature; in that case, the sphere B will advance from the side where the atmospheric pressure is weakest, that is towards A; the other case will happen when the electric charges ee' are of the same nature, then B will recede from A.

The common expression for the result of the pressures vanishes for both the spheres, when e or e' is nothing, that is, when one of them is in the natural state. This seems to indicate that they would then neither approach nor recede from each other, while, in reality, we know that in this case they always approach. This apparent contradiction is owing to the degree of approximation at which we stopped our developement of the above expression. We have supposed our two spheres very distant from each other, compared with the radii of their surfaces; the result of this is, that whatever be the quantity $4\pi r^2 e$, $4\pi r'^2 e'$ of external electricity which we have introduced into each of them, it will distribute itself almost uniformly over the two hemispheres, anterior and posterior; so that the difference of the pressures exerted against the air by these two hemispheres, which is the only cause of motion, will be very small, and it is to this degree of minuteness that we have confined our approximations in developing $E^2 - E'^2$.

If, however, the one of the two spheres, B for example, is only electrified by the influence of the other, which we always suppose very distant, the developement of its natural electricities will be still very feeble, and of the same order of minuteness with that to which we have confined our approximations; but this weak electricity still dividing itself between the two hemispheres of B, in a manner nearly equal, as in the example immediately above, the difference of pressures round the two hemispheres will become very minute in a still lower degree—will become a quantity of the second order of minuteness, and consequently, cannot be found in our developements, such as we have limited them. To obtain it complete, we must not, in the calculation of $E' + E_{\prime}'$ confine ourselves to quantities, independent of $\frac{r'}{a}$, but take its whole value. We will then have, first of all,

$$E' = e' - \frac{3e\,r^2}{a^2}\cos. u' + \frac{5e\,r^2\,r'}{2\,a^3}(1 - 3\cos.^2 u')$$

then changing $+x$ into $-x$, or $+\cos. u'$ into $-\cos. u'$, we will have,

$$E' = e' + \frac{3\,e\,r^2 \cos. u'}{a^3} + \frac{5\,er^2\,r'}{2a^3}\,(1 - 3\cos.^2 u')$$

then adding these two expressions,

$$E' + E_{\backslash}' = 2\,e' + \frac{5\,e\,r^2\,r'}{a^3}\,(1 - 3\cos.^2 u')$$

This complete value of $E' + E_{\backslash}'$ will now no more vanish when e' is nothing, but it will be seen that the terms which remain are of the order of those which we have neglected in our first approximation. Making, then, here e' equal to nothing, it remains,

$$E' + E_{\backslash}' = \frac{5\,e\,r^2\,r'}{a^3}\,(1 - 3\cos.^2 u')$$

we also find, as before,

$$E' - E_{\backslash}' = -\frac{6\,e\,r^2}{a^2}\cos. u'$$

with these values, the expression of the partial resulting force $\frac{K\,x\,\omega'}{r'}(E'^2 - E_{\backslash}'^2)$, or $K\,\omega'\,(E'^2 - E_{\backslash}'^2)\cos. u'$ becomes $\frac{-30\,K\,e^2\,r^4\,r'}{a^5}\,.\,\omega'\cos.^2 u'\,(1 - 3\cos.^2 u')$.

It only remains to take the sum of it over all the extent of the surface of the sphere B; but, in this operation, the variable factor, $\omega'\cos.^2 u'\,(1 - 3\cos.^2 u')$, will give a result proportional to the square of the radius r' of the sphere B, and which we may consequently represent by $K''\,r'^2$, K'' being a constant numerical co-efficient different from K'; thus, the total resulting force will at last be

$$\frac{-30\,K\,K''\,e^2\,r^4\,r'^3}{a^5}.$$

This force, then, will be of an order of minuteness, much inferior to that which we obtained at first, when e' was not supposed to be nothing, since the radii there are divided by the fifth power of the distance of the centres of the two spheres, instead of the simple square which we had in the other approximation. It is obvious, that experiments of this kind, made with the electric balance, by charging only one of the balls, might produce an error as to the true law of the phenomena, if the theory did not throw light upon them; for one might be led to conclude from them, that the apparent attraction determined in this case is not reciprocally as the square of the distance of the centres of the two spheres, which nevertheless would be contrary to the truth; consequently, when it is meant to put this simple law of the square to the test, the balls must not be allowed to approach so near to each other, that the electricity developed by their reciprocal influence may bear any sensible proportion to the quantities of external electricity introduced into them; and this is the reason, that, in these experiments, it is always more certain to employ, instead of balls, small circular disks of gilt paper; for, on account of the thinness of these disks, the quantities of vitreous or resinous electricity developed at their surfaces, having nearly no room to separate from each other, their actions on the exterior bodies must be always about exactly alike, and cannot, therefore, alter the results any more than if their developement had not taken place.

The theory, which we have thus explained in regard to spheres, applies equally well to bodies of any form whatever; but here the difficulty of the analysis prevents us from anticipating any thing but the general effects which the different pressures produce, without our being able to reduce them to numbers. Those who wish to enter into the details, will find them in Biot's *Physique Mathematique*, Tom. II. Here it will suffice to have established the general mode of reasoning applicable to all the questions of this kind, and to have followed out the whole developement for the single case, which analysis has been able as yet completely to surmount. We shall add, that before the theory had acquired its actual precision, it could not be clearly conceived how the attractions and repulsions, which in reality only take place between the electrical principles themselves, were communicated to the material particles of the electrified bodies; and philosophers were reduced to the necessity of denoting this effect by the vague word *tension*, which represented the electricity like a kind of spring placed between the bodies, and tending to make them approach or recede.

In the preceding observations, we have only attended to the statics and the dynamics of electricity, that is, to the laws of its equilibrium and of its motion. To complete these additions, it would be necessary still to consider its chemical action, concerning which many discoveries have also been made since the publication of the *Encyclopædia*; but it will be better to place these results under the article Galvanism, as they will there be united with a great number of others, which will mutually throw light upon each other, and at the same time will render more certain, and more general, the theoretical consequences which may be drawn from them. We shall only present here some necessary modifications of the ideas which may be formed from the *Encyclopædia*, in regard to the nature of the two electricities, and to the physical impressions by which their material existence seems to become manifest to our senses. The light which the electric spark excites in the air, does not by any means prove, that the electric principle itself is luminous, any more than the phosphoric odour, which the electrified points produce on the organ of smell, proves that this principle is odorous. It is now known by experiment, that every sudden stroke, every rapid motion, impressed on a mass of air, which cannot yield with sufficient agility, excites in it a degree of light; and, in order that it may thus be excited in the open air, it is sufficient that it be impelled more vigorously than its own resistance permits it to give way. Whatever may be the nature of electricity, we know that it produces upon bodies in which it is contained, and on those which it traverses, a repulsive force, which becomes, in many instances, extremely energetic. We know, besides, that, without any estimable mass for our most sensible balances, it may yet impress upon these bodies very rapid motions, when we accumulate it, and dispose it in such a manner, that the pressures which it exerts against the air around these bodies cannot mutually balance each other. Hence

we may conclude, by the laws of mechanics, that the velocity of its transmission must be immense; but with an excessive velocity, and a very great repulsive force, what more is wanting to compress the air, and even the rarest vapours, even to the point where the disengagement of light begins? This idea, which we believe was first proposed by M. Biot (*Annales de Chimie*, 1805, Tom. LIII. p. 321), seems to us to give a very plausible reason for these phenomena; and the possibility of so simple an explanation, is enough for authorizing us to reject as hypothetical the conclusion which has been too often drawn from this phenomenon, that the electric principle is heat, or a modification of heat. There is still less occasion to insist on the uncertainty of that other hypothetical conclusion, that the electric principle is odorous. Whenever it is discovered that this principle may occasion mechanical motions in lifeless bodies, and that its rapid transmission may excite muscular contractions in organised bodies, by a moment's reflection we can conceive that the same influence may excite tickling in the pituitary membrane, in such a manner as to produce in us a sensation like what the impression of a body really odorous may occasion. These phenomena, then, are not characters peculiar to the electric principles, and essential to their existence; they are very probably simple modifications which its repulsive force produces in bodies, or in us. We may venture to add, that they do not prove even its materiality; for what proof is there, that a repulsive force cannot be excited, or arise in any point of space, without being attached to sensible and ponderable particles? The only strong induction, the only one perhaps of really any weight as to the materiality of the electric principles, is, that in all the phenomena of their equilibrium and motions, they act exactly as two fluids would do, whose particles would mutually repel each other, and attract those of the other fluid reciprocally as the squares of the distances. This constitution being supposed, all the electrical phenomena become the rigorous mechanical consequences of it; can be anticipated with the most perfect precision, and can even be reduced to numbers in their minutest details, as well as in their most intricate windings, when the analysis may apply to them. Does not this, then, afford a very strong presumption, that these two principles are in effect and in *reality* such as this constitution, deduced from the phenomena, indicates?

Finally, Whatever the true nature of electricity may be, in itself, since the constitution which we have ascribed to the two electric fluids reproduces exactly and numerically all the phenomena, which as yet it has been possible to develope by calculus, this is enough to entitle us to admit this constitution in our farther inquiries. For we are authorized to conclude, from the verifications already established, that the real nature of electricity, whatever it may be, must conform itself to the facts with equal exactness; and, on the other hand, that, when applied to these facts, it will reduce itself to the same conditions which we have attributed to the two fluids; so that the facts will not flow from it otherwise, nor by other formulas, than what we now employ. But new observations, and even new applications, will serve, when the mathematical analysis will have become more perfect, to confirm or destroy the physical reality of the theory, and will show whether it is an exact and general interpretation of all the phenomena, or whether only an approximate and particular expression of those which till now it has embraced.

This progression of ideas may be already observed in the succession of the theories anterior to this, which we have here explained. And among these speculations one has been too justly celebrated, and too useful, to be passed over in silence. Most of the electric phenomena, if we look only to their general circumstances, may be represented, by supposing only the existence of a single electric fluid, of which a certain quantity is diffused through all bodies, and forms their natural state. The excess of this fluid in bodies produces what we have called the vitreous electricity; its deficiency what we have called the resinous electricity. Hence arise two states of the bodies, which the followers of this system denote by the terms *positive* and *negative*. They admit, also, that the particles of the electric fluid mutually repel each other; but as experience shows, that bodies in the natural state do not exert any action on each other, they are besides constrained to suppose, that the electric particles are attracted by the matter itself of the bodies; and lastly, as it is proved by a profound discussion and calculation, that even this condition will not be sufficient to establish the equilibrium, it becomes necessary farther to admit, that the particles of all bodies exert on each other a repulsive action, sensible, like the electric influences themselves, at great distances, and varying according to the same laws with the distance. Franklin, who first imagined this system, and who employed it ingeniously to unite all the electric phenomena known in his time, and which till then were scattered and unconnected together,—Franklin did not perceive the consequence to which his hypothesis led. Æpinus was the first who, by an exact analysis of all the forces by which the electric equilibrium was brought about, discovered the necessity of a repulsion between the particles of the bodies (*Tentamen Theoriæ Electricitatis et Magnetismi*, p. 39), and, after him, the celebrated philosopher Henry Cavendish was led to the same consequence; for he made this repulsion one of the fundamental conditions of his hypothesis on the nature of electricity, published in the *Philosophical Transactions* for the year 1771, and which accords exactly with the hypothesis of Æpinus.

Although the existence of such a repulsive force between material particles of all bodies may, at first view, seem quite opposite to the general phenomena of the universe, particularly to the great law of celestial attraction, it is not so in fact; for this repulsion, as it is employed by Æpinus and Cavendish, would be exactly balanced by the mutual attraction which the hypothesis supposes to exist between the electric fluid and all material substances, when they are in their natural state of electricity; so that no resulting force would be exerted in this state by their mutual actions; and then, all other properties,

or forces emanating from the bodies, as attraction seems to be one, could equally exist and manifest their power in the state of electrical saturation, as well as if there existed no repulsive action whatever between the matter of bodies. In effect, if we admit such a state of things, we may connect together by it a great number of electric phenomena, conceive their mutual dependence, and anticipate them, not, indeed, as to the quantity and number, but in their general circumstances. This view of the subject is fully discussed in the *Encyclopædia*, where the results of this system are explained in detail. We thus explain, for example, the attractions and repulsions of electrified bodies, and even the developement of electric properties in bodies, in the natural state, by the sole influence at a distance of an electrified body. But, from the time when this theory was first imagined, many circumstances of the phenomena have been more accurately, and more precisely fixed, and many have been limited by exact measurements. In fine, we know them by numbers; and it is in number that the theory must now represent them. When Æpinus and Cavendish wrote, the law of electric attractions and repulsions was not yet ascertained by experiment. It could be doubted, then, whether these forces varied according to the cube, to the square, or to some other power of the distances; and it was consequently impossible to compute numerically the distribution of electricity in the bodies where it disposes itself by its proper equilibrium, or to assign the proportion of its allotment between two bodies of a given form, since these delicate effects are dependent on the laws by which the action of the fluid upon itself and other bodies is regulated. In the law of the cube, for example, the distribution and the division of electricity would be different from what they are in the law of the square, and the former may be now rejected, as giving consequences contrary to actual observation. In like manner, if we now introduce the law of the square in Æpinus's or Cavendish's hypothesis, we would probably be led to consequences which would be found inconsistent with the exact measurement of these phenomena which we now possess; but this deduction has not yet been made, and seems very difficult to be done. Happily it does not now appear to be of any importance, since the hypothesis so pursued could have no greater success than to agree with the facts, which the theory of the two fluids already does in the most exact manner, and what is of no small consideration, with a complete evidence, simplicity, and facility to be expressed by analysis. (Z. Z.)

ELLIPTIC TURNING. Wood and other substances are turned into an elliptic form by means of a chuck, which is applied on the common turning lathe. This chuck is on the principle of the trammel, Plate LXXIX. fig. 1. The grooves in the chuck are much wider than in the trammel, and the points of the chuck that correspond to C, D, of the trammel, fig. 1, remain fixed, and in one horizontal line, whereas in the trammel it is these points that are put in motion.

Illustration of the Principle.

If two straight lines, crossing each other, be drawn on a piece of transparent paper or mica; and if this transparent paper be laid upon a sheet of white paper, with two points marked on it; and if the transparent paper be moved round, so that the cross lines shall travel over the two points, in like manner as the two points, C, D, in the trammel, fig. 1, travel over the cross grooves of the trammel; and if the point of a pencil be held fixed, and touching the transparent paper, so as to leave a trace on the transparent paper, when the paper is moved; then after the transparent paper has made a revolution, the trace left on it by the point of the pencil is an ellipse. This method of describing an ellipse represents the action that takes place in the chuck for turning ellipses; the point of the pencil which remains unmoved is in the same situation as the turner's gouge; the transparent paper, which receives the trace of the ellipse from the fixed pencil, is analogous to the wood, which is to be turned into the form of an ellipse by the fixed cutting gouge.

Description of the Chuck.

In fig. 2, the chuck is represented as fitted on a common turning lathe, of which A is the pulley of the maundrel, B and C are the sides of the frame supporting the pulley, P the rest, D the frame in which the rest slides, E F the feet of that frame, I the nut and screw which serve to fix the rest, G H are the continuation of the sides B C. K is the elliptic chuck, with two grooves, through which the knobs of the slider pass; these knobs are connected by a strong bar of iron screwed into their ends, and on this bar of iron is seen the screw for fastening the board, to which is fixed the wood or other substance which is to be turned elliptically.

Fig. 3. shows the other side of the chuck, which, in fig. 2, is turned towards the side of the frame C. N, in fig. 3, is the board with the grooves, which contain the slider O. In the middle of N is seen the end of the screw, which is fixed to the maundrel. The board N has a circular motion, being fixed on the axis of the maundrel, whilst the slider O, at the same time that it is carried round by the circular motion of N, is constrained to perform other motions by the grooves in N, and by the groove in O, fig. 3, which slides on the ring M, fig. 4.

In fig. 4, L is a part of the side C of the maundrel frame, with the ring M fastened to it. On this ring, the broad groove in the slider O, fig. 3, moves when the lathe is set a going; and this groove is at right-angles to the grooves in N, fig. 3, in which the knobs of O move. In fig. 4, it is seen that the centre of the ring M may be made to coincide with the centre of the spindle of the maundrel, in which case a circle is described. If the ring is fixed, so that the centre of the ring does not coincide with the centre of the maundrel, an ellipse is described by the wood screwed upon the bar of O, in fig. 2; and the most eccentric ellipse that the machine describes is obtained, when the maundrel is at the circumference of the ring. The centre of the spindle of the maundrel, and the centre of the ring M, are always in one immoveable horizontal line, and are analogous to the

Elliptic Turning || Elliptograph

points C, D, of the trammel, fig. 1. In fig. 3, it is seen that the sides of the grooves may be brought nearer together by means of screws, so that the sliders and the cylindric ring may fit exactly to the grooves. The best elliptic chucks are made of brass. See *Mechanical Exercises*, by Peter Nicholson, London, 1812. (Y.)

ELLIPTOGRAPH, an instrument for drawing ellipses. The trammel is an instrument that has long been known and used for describing ellipses. On the principle of the trammel, Mr Farey constructed his elliptograph in a form much more commodious for drawing. Mr Farey's elliptograph is represented at fig. 5. Plate LXXIX. The circle A slides between the two parallel rulers D E. The circle B slides between two parallel rulers F G, at right angles to the former. In this way, if a line, joining the centres of the circles, is made to revolve, M, the extremity of that line, will describe an ellipse in the same manner, as the extremity E of the line C D E, fig. 1, does in the trammel. The elliptograph may be considered as a trammel, in which the pins C and D, fig. 1, are enlarged into the circles A and B, fig. 5. The pinion at K, fixed to one of the arms of the lower circle, acting on a rack screwed to the upper circle, serves to alter the distance of the centres of the circles A and B, and, by so doing, this pinion serves to vary the eccentricity of the ellipses which the instrument describes. When the centres of the circles A B coincide, the describing pen M draws a circle. When the centres are removed from each other, and on the circles being turned round, an ellipse is described by the pen; and when the distance of the centres is increased, the eccentricity of the ellipse is increased. When the pen is at the centre it describes a straight line, continually moving to and fro on that line when the circles are turned round. The two circles are fixed together by screws, and can only be made to slide the upper circle over the lower by the action of the pinion K. The pinion at L moves a rack, by which the describing pen M, which draws the ellipse, is brought nearer to the centre, for the purpose of drawing a small ellipse; and removed farther from the centre of the ellipse, when a large one is to be drawn. The size of the ellipse may be increased as far as the size of the instrument will admit. The pair of rulers D E are placed below the pair F G, as is seen in fig. 6. The instrument, when used, is held upon the paper with the thumb and a finger of the left hand at the nuts N O, and the circles are moved by applying the right hand to the pins *f*, the pen M, pressing by its weight on the paper, then describes the ellipse.

Fig. 7 shows H the socket for the compasses, with the centre pin on which the socket moves; and the pinion L and rack *h* for moving along the frame *g* between the bars; and the other pinion K for separating the circles.

The ruler P has two points to fix the instrument to the paper. The ruler is united to the frame by screws, which serve to adjust the position of the instrument after the ruler has been fixed to the paper.

By means of the elliptograph, any ellipse can be described, of which the long and short axis are given, provided it does not exceed the size of the instrument. When an ellipse is to be described, draw on the paper the longer and shorter axis, bisecting each other; place the instrument on the paper so that the centre of the four rulers appears to coincide with the centre or the intersection of the two axes of the ellipse; fix the instrument in this situation by the points that go into the paper: by the pinion L move the pen to one extremity of the short axis of the ellipse; turn the circles half round to see if the pen comes to the other end of the short axis; if it does not, adjust the error one-half, by moving the pen by the pinion L, the other half by moving the frame on the paper; continue this adjustment till the pen, setting out from the one end of the short axis, arrives in a half revolution at the other end. Next, by means of the pinion K, bring the pen to one end of the long axis of the ellipse; turn the circles half round, and if the pen reaches the other extremity of the long axis of the ellipse, the instrument is rectified; if not one half of the error is to be corrected by moving the circles by the pinion K, and the other half by moving the instrument to a side on the paper by means of the nuts N, O. The instrument is now adjusted, and the pen resting on the paper traces the ellipse required when the circles are turned round by the handles.

Elliptograph || Embankment.

Mode of Using the Instrument.

10

Elliptograph for Engraving.

An instrument similar to the elliptograph has been employed for engraving ellipses on copper plates, and for dividing these ellipses accurately, so as to give the perspective representation of a circle divided into equal parts, both in the case where the distance of the eye is limited, and in the orthographic projection. The *Society for Encouraging Arts* rewarded Mr Farey with their gold medal for his invention, and a description of the elliptograph is contained in the thirty-first volume of the *Transactions* of that Society. (Y.)

EMBANKMENT, a mound, or wall of earth, or other materials, used as a defence against the inundations of rivers, or the extraordinary flux of the sea.

The great value of alluvial soil to the agriculturist, no doubt, gave rise to the invention of banks, or other barriers, to protect such soils from the overflowing of their accompanying rivers. The civilized nations of the highest antiquity were chiefly inhabitants of vallies and alluvial plains; the soil, moisture, and warmth of which, by enlarging the parts, and ameliorating the fruits of the vegetable kingdom, afforded to man better nourishment, at less labour than could be obtained in hilly districts. The country of Paradise, and around Babylon, was flat, and the soil a saponaceous clay, occasionally overflown by the Euphrates. The inhabited part of Egypt was also entirely of this description. Historians inform us, that embankments were first used by the Babylonians and Egyptians, very little by the Greeks, and a good deal by the Romans, who embanked the Tiber near Rome, and the Po for many stadia from its embouchure. The latter is perhaps one of the most singular cases of embankment in the world.

The oldest embankment in England is that of Romney Marsh, as to the origin of which, Dugdale remarks: "that there is no testimony left *to us* from any

record or historian." (*History of Embanking and Draining.*) It is conjectured to have been the work of the Romans, as well as the banks on each side of the Thames, for several miles above London, which protect from floods and spring tides, several thousand acres of the richest garden ground in the neighbourhood of the metropolis.

The commencement of modern embankments in England took place about the middle of the seventeenth century, under Cromwell. In the space of a few years previously to 1651, 425,000 acres of fens, morasses, or overflown muddy lands, were recovered in Lincolnshire, Cambridgeshire, Hampshire, and Kent; and let at from 2s. 6d. to 30s. an acre. (Harte's *Essays*, p. 54, 2d edit.) Vermuyden, a Fleming by birth, and a colonel of horse under Cromwell, who had served in Germany during the thirty years war, was the principal undertaker of these works. The works of this sort constructed in our own times will be found described in the *Agricultural Reports* of the maritime counties, especially of Lincolnshire, by Arthur Young.

Previous to entering on the detail of the different descriptions of banks for the purpose of embanking, we shall here observe, that the pressure of still water against the sides of the vessel containing it, being as its depth, it follows, that a bank of any material whatever, impervious to water, whose section is a right angled triangle, and the height of whose perpendicular side is equal to that of the water it is to dam in, will balance or resist this water, whatever may be the breadth of the surface of the latter; and, therefore, that as far as width or extent is concerned, it is just as easy to exclude the Atlantic Ocean as a lake or a river of a few yards in width.

The Earthen Wall.

1. The earthen wall (fig. 1. Plate LXXIX.) is the simplest description of embankment, and is frequently erected by temporary occupiers of lands on the general principle of enclosing and subdividing, which is sometimes made a condition of tenure between the landlord and tenant. This wall applies to lands occasionally, but rarely overflown, or inundated; and is set out in a direction generally parallel to the river or shore. Its base is commenced on the surface from two to five feet wide, regularly built of turf on the outsides, with the grassy sides underneath. The middle of the wall is filled up with loose earth. The wall is carried up with the sides bevelled towards the centre, so as to finish in a width of one foot or eighteen inches at five or six feet in height. In the inside of such walls, and at the distance of three or four feet, a small open drain is formed, as well to collect the surface water of the grounds within, as that which, in time of floods, will necessarily oose through a wall of this construction. The water so collected is let through the wall by tubes, or tunnels of boards, with a valve opening outwards on their exterior extremity. Such a tube and valve is represented by fig. 2. When the flow of water from without approaches, it shuts the valve, which remains in this state till the flood subsides, when the height of the water within being greater than that without, it presses open the valve and escapes. Walls and valves of this kind were erected about the year 1800, on the estate of the Earl of Galloway near Wigton by Mr Hannah, tenant for life of Cue farm; and by Mr Hutchinson, tenant for thirty years of Mersehead farm, on the Solway Firth. (*Farmer's Magazine.*) They are common enough in the drier parts of the fenny districts of Lincolnshire and Cambridgeshire; and in Caernarvonshire 1800 acres were, in 1804, completely protected in this way on the estate of Tre Madoc by the proprietor, who has since made greater efforts in embanking, to be afterwards described.

The Earthen Mound.

2. The earthen mound (fig. 3.) is the most general description of embankment, and as it is executed at considerable expence, is only undertaken by such as have a permanent interest in the soil. This barrier applies to sea lands overflown by every spring tide, and to alluvial plains inundated by every flood. It is set out in a direction parallel to the shore, and to the general turns of the river, but not to its minute windings; and it is placed farther from or nearer to the latter, according to the quantity of water in time of floods, the rapidity of the current from the declivity of the bed, the straight course of the stream, and the intended height of the bank. The two sides of such a mound are generally formed in different slopes. That towards the land is always the most abrupt, but can never be secure if more so than 45°; that towards the water varies from 45° to 15°; the power of the bank to resist the weight of the water, as well as to break its force when in motion, being inversely as its steepness. The power of water to lessen the gravity of bodies, or, in other words, to loosen the surfaces over which they flow or stand, is also lessened in a ratio somewhat similar.

The formation of such a mound consists merely in taking earth from the general surface of the ground to be protected, or from a collateral excavation, distant at least the width of the mound from its base line, and heaping it up in the desired form. The surface is then in general cases covered with turf, well rolled in order to bind it to the loose earth. The earth of such mounds is generally wheeled by barrows; but sometimes it is led by carts placed on a wooden roller instead of wheels, which, with the treading of the horses, serves in some degree to consolidate the bank.

The excavation within serves the same purpose as the open drain in the *earthen wall*, and similarly constructed sluices or valves are introduced on a larger scale. Sometimes also the interior water is drawn off by windmills, and thrown over the mound into the river. This is very common in Huntingdonshire, and might be greatly improved on by employing steam-engines for entire districts, one of which, of a ten horse power, would do the work of twenty mills, and this in calm weather, when the latter cannot move.

Embankments of this description are the most universal of any, and their sections vary from a scalene triangle of ten feet in base, and three feet in height, as on the Forth near Stirling, and the Thames at Fulham, to a base of 100 feet, and a

Embankment.

height of ten feet, as in the great bank of the Ouse, near Wisbeach. The great rivers of Germany and Holland are embanked in this way, when so far from the sea as to be out of the reach of the tide; as the Vistula at Marienwerder, the banks of which, near Dantzic, are above fifteen feet in height; the Oder, the Elbe, &c. All these banks are closely covered in every part with a grassy surface, and sometimes ornamented with rows of trees.

But, near the sea, where such banks are washed by every tide when the course of the wind is towards the shore, and by all land floods and spring-tides, grass is only to be found on and near their summits. The rest of the bank is bare, and to preserve it from the action of waves, currents, and the stones, pieces of wood, and other foreign matters which they carry with them, the surface is covered with gravel, reeds, or straw, kept down by pieces of wood; faggots, wicker hurdles, nets of straw-ropes, or any other contrivance, according to the situation, to prevent the washing away of the bank. It is common to attribute to these coverings the power of breaking the force of the waves; but this power depends, as we have already stated, on the slope of the bank and its smoothness; and the use of the surface covering, and of the constant attention required to remove all obstacles which may be left on it by floods and tides, is to prevent the loosening power of the water from wearing it into holes. For this purpose, a sheet of canvass or straw-netting is as good, whilst it lasts, as a covering of plate-iron or stone pavement.

All banks whatever require to be constantly watched in time of floods or spring-tides, in order to remove every object, excepting sand or mud, which may be left by the water. Such objects, put in motion by the water, in a short time wear out large holes. These holes, presenting abrupt points to the stream, act as obstructions, soon become much larger, and if not immediately filled up, turfed over, and the turfs pinned down, or the new turfs rendered by some other means not easily softened and raised up by the water, will end in a breach of the bank. A similar effect is produced by a surface formed of unequal degrees of hardness and durability. The banks of this description in Holland, at Cuxhaven, and along the coast of Lincolnshire, are regularly watched throughout the year; the surface protection is repaired whenever it goes out of repair; as is the body of the bank in the summer season.

Varieties of the Mound.

Mound with Puddle-Wall.—It generally happens that the earth of such banks is alluvial, and their foundation of the same description; but there are some cases where the basis is sand, silt, or gravel; or a mud or black earth, as in some parts of Cambridgeshire and Lincolnshire, which does not easily become so compact. Here it is common, before beginning the bank, to bring up what is called a puddle-ditch, or section of clay, in the centre of the highest part of the mound in the direction of its length, and of three or five feet wide, according to the depth of the silt and the intended height of the bank. When the clay of this puddle-ditch is well worked, either by men's feet or clay rammers, the bank will be perfectly impervious to water, and if against a mild stream or shore, need not contain such an accumulation of earth as where the imperviousness of the bank to water depends chiefly on the mass of materials. An important point to attend to in this variety of mound is, to found the section, or wall of clay, so deep as to be in contact with a stratum either by induration, or its argillaceous nature, impervious to water.

Mounds with reversed slopes, (fig. 4.)—In some cases of embanking rivers, as where they pass through parks, it is desirable to conceal, as much as possible, the appearance of a bank from the protected grounds, less able to break the force of waves. Here the mound is simply reversed, the steepest side being placed next the water. It is proper to observe, that such banks are not so strong by the difference of the weight of the triangle of water which would rest on the prolonged slope, were it placed next the river, and are more liable to be deranged in surface in proportion to the difference of the slopes.

Mound faced with stones.—This is the same species of mound, with a slope next the water of forty-five or fifty degrees, paved or causewayed with stones or timber. In Holland this pavement or causeway is often formed of planking or bricks; but in England generally with stones, and the mortar used is either some cement which will set under water, or, what is better, plants of moss firmly rammed between them. The objection to such banks are their expence, and their liability to be undermined invisibly by the admission of the water through crevices, &c. They are, therefore, chiefly used where there is little room, or where it is desirable to narrow and deepen the course of a river.

Mound protected by a wicker hedge.—This is a Dutch practice, and, where appearance is no object, has the advantage of not requiring watching. Wicker-work, however, subjected to the strain of waves, will be obviously less durable than where it lies flat on the ground, and can only decay chemically. This wicker hedge is sometimes a series of hurdles supported by posts and struts; but generally in Britain it is a dead hedge or row of stalks wattled or wrought with bushes presenting their spray to the sea or river. Besides placing such a hedge before a bank, others are sometimes placed in parallel rows on its surface; the object of which is to entrap sand, shells, and sea-weeds, to increase the mass of mound, or to collect shells for the purpose of carrying away as manure.

The sea wall (fig. 5.) is an embankment formed to protect abrupt and earthy shores or banks of rivers, and consists of a wall, varying in thickness, and in the inclination of its surface, according to the required height and other circumstances. Belidor in his *Traité de Hydraulique*, has given the exact curve which the section of such a wall ought to have, in order to resist loose earth, and which is somewhat greater than what we have given in the figure referred to, where the earth behind the wall is supposed to be chiefly firm. Some fine examples of such walls, for other purposes, occur in the CALEDONIAN CANAL, and perhaps the finest in the world are the granite walls which embank the Neva at Petersburg, the construction of which may serve as

an example of a river case with a foundation of soft bog earth. A space of the river, say 100 feet long, and 20 wide along shore, being inclosed by a double row of piles, and filled in with loam in the usual way, the water is pumped out, and the ground excavated about ten feet deeper than the margin of the bed of the river. Poles are then inserted nearly as close as they can be put in, and driven to their full length. When finished this foundation occupies a breadth of from 12 to 18 feet, generally 15. The tops of the piles are now cut level, and covered with planks, and on this is raised a mass of brick-work for five or six feet, sloping on both sides as it ascends towards the centre line of the wall. In the course of rising six or seven feet, it is narrowed to five feet, and is within five feet of the bed of the margin of the river. Here the granite facing begins in immense blocks, and is continued at a slope of 15° from the perpendicular till it reaches the surface of the intended pathway. Here the wall from three feet is narrowed to an upright parapet, eighteen inches wide; and at four feet of height it is finished in a projecting coping of Finnish granite. The voids on each side of the wall are now filled with earth, the pavement on the land side (generally narrow) completed, and the piles removed, and another length taken in to repeat the operation.

There is another mode, adopted in Petersburg, of building under water by driving the piles and cutting them over level with a machine, and then sinking caissons of brick-work. This mode, however, is unsuitable for sea walls in general, which ought to be founded as deep as possible, and, at all events, under the bed of the water. The motion of the Neva is so slow as hardly to render this worth attending to.

In Britain, such walls are fortunately rare; for in proportion as it is agreeable and flattering to self-love to protect or gain lands never before cultivated, it must be mortifying to be obliged to protect such as have long been subjected to agriculture, and where success can only be said to have a negative advantage.

Embankments for fixing Drifting-sands, Shells, or Mud.—In several tracts of coast, the sea at ordinary tides barely covers a surface of sand; and these sands in dry weather, during high winds, are drifted and blown about in all directions. Great part of the north shores of the Solway Frith, of Lancaster Bay, and of the coast of Norfolk, is of this description. Mr Young, in his *Farmer's Letters*, informs us, that a considerable part of the county of Norfolk was drift-sand, even as far inland as Brandon in Suffolk, before the introduction of the turnip culture; and Harte (*Essay I.*) states, that some of what is now the richest land in Holland, was, about the middle of the sixteenth century, of this description. The suggestion of any mode, therefore, by which, at a moderate expence, such tracts could be fixed, and covered with vegetation, must be deemed worthy of a place in this article.

The mode which nature herself employs is as follows: After the tides and wind have raised a marginal strip of sand as high as high water mark, it becomes by degrees covered with vegetation, and chiefly by the *Elymus arenarius*, *Triticum junceum*, various species of *Juncus*, and sometimes by the *Galium verum*. With the exception of the first of these plants (the leaves and stalks of which are manufactured into mats and ropes in Anglesea, and the grain of which is ground and used as meal in Ireland), they are of no other use than fixing the sands, which, being composed in great part of the debris of shells, expand as they decay, and contribute to raising the surface still higher, when the fibrous roots of good grasses soon destroy the others.

To assist nature in fixing drift-sands, it is only necessary to transplant the *Elymus*, which is to be had in abundance in almost every sandy coast in Britain; and as it would be liable to be blown away with the sands, if merely inserted in the common way, it seems advisable to tie the plants to the upper ends of *willow* or *elder* rods, of two or three feet in length, and to insert these in the sand, by which means there is the double chance of the grass growing, and the truncheon taking root. The elder will grow exposed to the sea breeze, and no plant throws out so many and such vigorous roots in proportion to its shoots.

The mode by which such sands were fixed in Holland was by the formation of wicker work embankments, and by sticking in the sands branches of trees, bushes, furze, &c. in all directions. These obstructed the motion of the sands, and collected masses of sand, shells or mud, and sea-weeds around them, which were immediately planted with some description of creeping grass; or, what was more frequent, covered with a thin coating of clay, or alluvial earth, and sown with clover.

Though the most certain and least expensive mode of gaining such lands be undoubtedly that of seconding the efforts of nature, by inserting bushes, and planting the *Elymus* in this way, yet it may sometimes be desirable to make a grand effort to protect an extensive surface, by forming a bank of branches, which might, in a single or in several tides, be filled with sand and shells. It is evident, that such a bank might be constructed in various ways; but that which would be most certain of remaining firm, and effecting the purpose, would be one regularly constructed of framed timber, the section of which would resemble a trussed roof; each truss being joined in the direction of the bank by rafters, and the whole inside and surface stuck full of branches. To retain it firm, piles would require to be driven into the sand, to the upper parts of which would be attached the trusses. The height of such a barrier would require to be several feet above that of the highest spring-tides; and the more its width at base exceeded the proportion of that of an equilateral triangle the better.

A more economical mode, and one, therefore, suited to a less extensive scale of operation, is to intersect a sandy shore in all directions, with common dead, or wicker work hedges, formed by first driving a row of stakes six or eight feet into the ground, leaving their tops three or four feet above it, and then weaving among these stakes, branches of trees, or the tops of hedges. The Dutch are said to weave straw ropes, and thereby to collect mud in the manner of *warping*. This mode being little expensive,

seems to deserve a trial in favourable situations; and, in so doing, it must not be forgotten, that much depends on the immediate management of the surface, after it is in some degree fixed. In an extensive trial of this sort at present in progress, on the west coast of Scotland, under an English gentleman, seeds and roots are baked in a mixture of loam and dung in the gravel, and then formed into masses, and scattered over a sandy surface. These, from their weight, will not, it is thought, be moved by the water or the wind; but becoming more or less covered with sand, the mass will be kept moist, and the seeds and roots will grow, and, fixing themselves in the soil, will in time cover the surface with verdure. The experiment is ingenious, and we hope will be crowned with success.

Embankments for straightening the Course of Rivers.—Where a river in a fertile valley is very circuitous in its course, land may be gained, and a more rapid efflux of the water produced, by straightening its course. The best plan in general for effecting this is, to find an entirely new bed or course for the river; otherwise, when it passes alternately through new soil, and through a part of its old bed, its action on surfaces which are so different in regard to induration ends, if great care is not taken, in holes and gulleys in the new bank, which require to be constantly filled up with loose stones thrown in, and left to be fixed by the pressure and motion of the water.

The embankment used in straightening the course of rivers is almost always the mound, with a clay wall in the centre, varying in width according to the depth of the different parts of the old bed of the river which it has to intersect. The materials for these banks are obtained from excavations for the new bed.

The pier, called the *Protecting Pier*, is to be considered as a species of embankment, whose object is to prevent the increase of partial breaches made in the banks of rivers, by accidental obstructions during floods. A tree or branch carried down by a stream, and deposited, or accidentally fixed or retained in its banks, will repel that part of the stream which strikes against it, and the impulse (counteracted more or less by the general current) will direct a substream against the opposite bank. The effect of this continual action against one point of the opposite bank is, to wear out a hole or breach; and the protecting pier is placed so as to receive the impulse of the substream, and reverberate it to the middle of the general stream. If this pier is not placed very obliquely to the substream, as well as to the general stream, it will prove injurious to the opposite bank, by directing a subcurrent there as great as the first; and, indeed, it is next to impossible to avoid this; so much so, that Mr Smeaton, in every instance in which he was consulted in cases of this sort, recommended removing the obstacle where that could be done, and then throwing loose stones into the breach. A perfect bed of a river would be a perfect half cylinder, and therefore we are decidedly of opinion that Mr Smeaton's mode is the best, as tending to maintain, as much as possible, this form. Mr Marshal (*Treatise on Landed Property*) has treated on piers of this description at considerable length; but a very little reflection will show, that they are more likely to increase than to remedy the evil they are intended to cure. We have seen the injurious effects of such piers on the Tay and the Dee, and on a part of the Jed near Crailing they are so numerous, that the stream is, to use a familiar phrase, bandied about like a football, from one shore to the other; behind every pier an eddy is formed, and if the stream does not strike it exactly, a breach in the bank. Many of these piers have, in consequence, been taken down.

The use of such piers can only be justified where the obstruction, from ill-neighbourhood or some such cause, cannot be removed from the opposite bank; or where, as is sometimes the case, it arises from an island of sand or gravel thrown out by the river near its middle, and which, however absurd it may appear, the interested parties cannot agree as to who may remove it. The case of buildings also being in danger may justify such a pier for immediate protection; but, if such breaches are taken in time, a few loads of loose stones will effect a remedy without the risk of incurring or occasioning a greater evil.

Such piers are frequently constructed of wicker work; either a mere wicker hedge projecting into the water, as is common where the rivers are of slow motion,—as in England, and particularly on the Thames, Tame, and Severn; or a case of wicker work filled with stones, as is common where the motion is rapid,—as in Scotland, and particularly on the Esk, Tweed, Tay, and Clyde.

Embankments to serve as Roads are generally mounds without clay walls, carried through countries liable to be overflown, without reference to protecting any part from water, through lakes or marshes, or across straights of the sea, &c. The earth, in such mounds, is generally allowed to take its own slope on both sides, which is commonly from 40° to 45°, and the width at top is regulated by that of the intended road. The materials, when the mound is formed in a country merely liable to be overflown, as in many parts of Lincolnshire and Huntingdonshire, are excavated from ditches, or taken from the surface on each side of the mound. In Holland, the roads formed on such mounds are bounded by rows of trees; a practice which, it is to be regretted, has not been more attended to in England, where accidents not unfrequently happen in the night, and particularly on the Boston and Wisebeach roads; both of which are formed in great part on such mounds, unprotected by hedges, rails, or trees. In passing through part of a lake, or strait, or marsh, the earth must, of course, be taken from the firm ground on the shores; and here the ground being generally soft below, the first operation is to lay a foundation, three or four feet thick, of branches or faggots of copeswood, in order that the mound may sink in a body. The next thing, the direction of the mound being marked out by a line of poles placed along its centre, is to begin at one end, and wheel, or cart on earth, throwing it down in the direction of the bank, and raising it to its proper height and width; leaving the slopes at the sides to

ELLIPTOGRAPH. *PLATE LXXIX.*

Fig. 1.

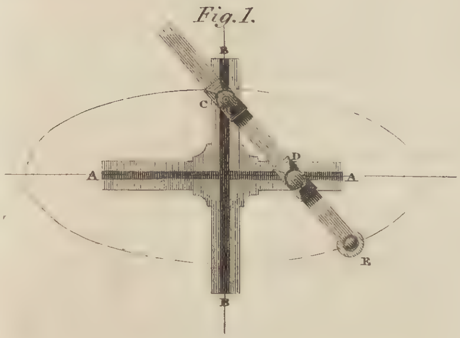


Fig. 7.

Fig. 6.

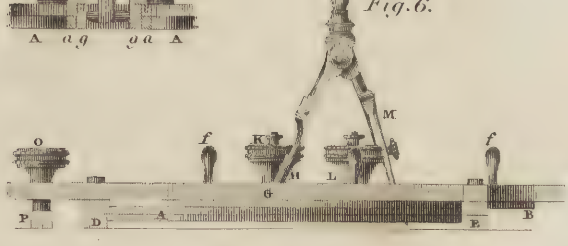
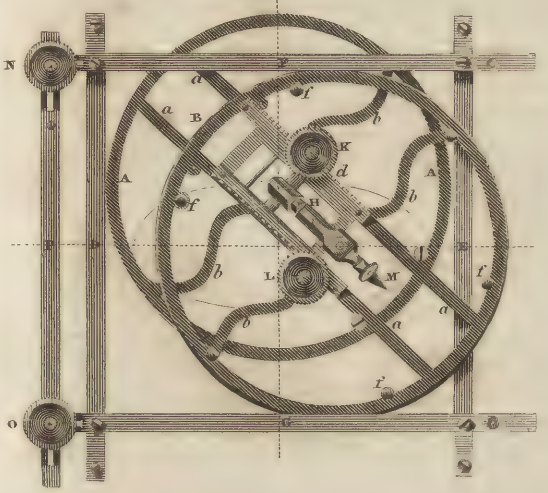


Fig. 5.



ELLIPTIC TURNING.

Fig. 3.

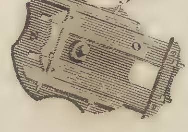
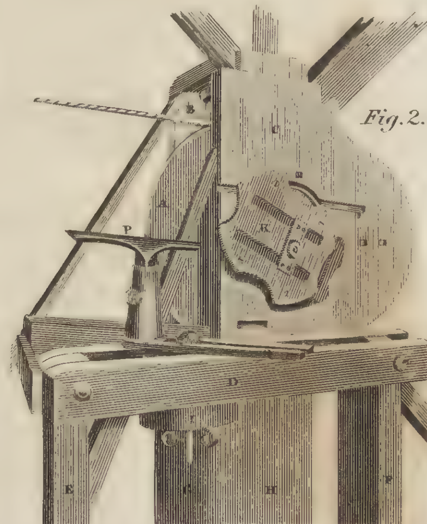


Fig. 4.

Fig. 2.



EMBANKMENT.

Fig. 1.

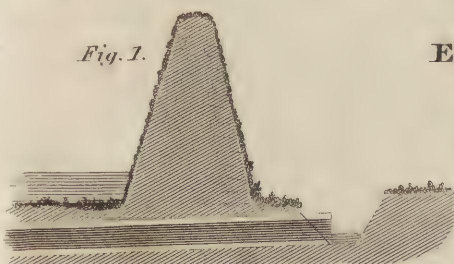


Fig. 2.

Fig. 3.

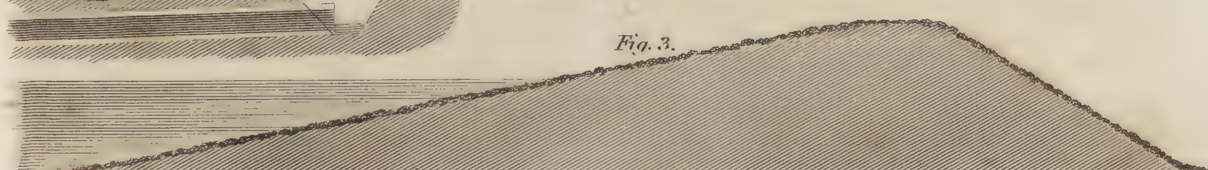


Fig. 4.

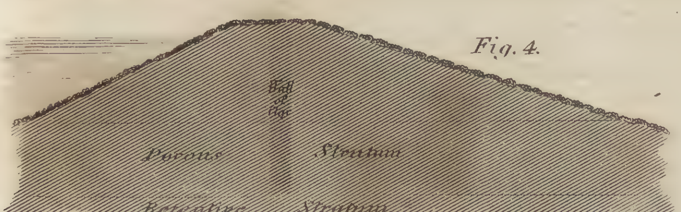
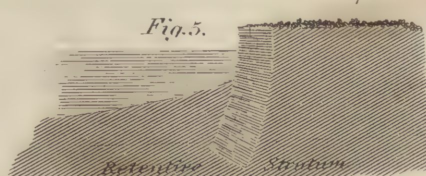


Fig. 5.



Published by A. Constable & C°. 1819.

Eng.d by W. & D. Lizars

adjust themselves, either by the gravity of the material alone, or jointly with the loosening and spreading operation of the water.

The noblest attempt of this sort ever made in Britain was that of W. A. Madocks, Esq. M. P., to unite the counties of Merioneth and Cardigan by a mound across an estuary and embouchure of the Glasslyn two miles wide. Mr Madocks had, in 1802, succeeded in protecting from spring tides, by a wall or bank of the first species, 1800 acres of good alluvial soil, which he let at from 30s. to 50s. *per* acre; and his enterprising spirit induced him to contemplate the idea of gaining the whole bay or mouth of the stream, extending to nearly 4000 acres of alluvial and sandy earth, overflowed in great part by every tide. Besides the mere gaining of the land, this patriotic improver had another object in view; that of uniting two maritime points in two counties which at that time were separated by a day's journey; and, by effecting this, he would, at the same time, have rendered practicable a new line of road from Worcester along the top of this embankment, through a creation of his own, called the town of Tre Madoc, to the newly-formed harbour of Porthdynlleyn; by which 40 miles would have been saved to the public between Dublin and London, and 50 between Dublin and Bath, &c.

After consulting various engineers, the first operation was begun in 1807, and consisted in forming an immense bridge of flood-gates in the solid rock of the shore; as such a bridge and gates could not be formed in any part of the mound. The use of this was to admit the exit of the river. This done, the mound was commenced from both shores, and rocky, sandy, and clayey materials thrown down in the direction of the mound, and left to take their own slope. The greater part of these materials were argillaceous rock broken into small pieces, which being mixed with clay the mound would have been of the strongest texture. As the work proceeded, an iron rail-road was laid along the top of it, and extended to the quarries and excavations, by which means much labour was saved. In the course of three years the work was brought within fifty yards of meeting in the middle, but was found extremely difficult to close from the rapidity of the influx and reflux of the tide. This difficulty, however, would have been overcome, and the proposed improvement effected at little more than the estimated cost, L. 20,000, had not the various and extensive projects in which the proprietor was at that time engaged, led him into pecuniary difficulties which put an end to the undertaking, and, as is usual in such cases, called forth popular clamour against the plan. It is but justice, however, to those concerned to state, that the very plan now put in execution was contemplated above a century ago by Sir Hugh Middleton, who then wrote to a friend, that, if he were not so deeply engaged in the scheme of bringing water to London, he should certainly engage in it.

Very little has been written on the subject of embankments, as a separate branch of art, by British authors. Dugdale's work is entirely historical and topographical. But the writings of Smeaton, Young, Gregory, &c. contain the general principles on which is founded the art of embanking, and every other operation connected with water.

(A.A.A.)

EMIGRATION.

The natural propensity of mankind is to settlement and rest, and this principle is still farther strengthened by the influence of local associations over the mind. Every one is strongly attached to the place of his birth, or to the place where he has passed his earlier years, and it may be generally remarked, that, in whatever spot man fixes his abode, there he takes root. Habits and sympathies are created, strong attachments are formed, and the longer he remains in any particular place, his aversion to change grows upon him. The power of early associations over the mind is exemplified by constant experience. How many of those adventurers who, at an early age, had quitted their home and their country in pursuit of fame or fortune, do we see daily returning to revive those local affections which, being deeply impressed on the heart while it was yet warm and susceptible, neither time nor distance has been able to efface? and to the powerful influence of the same tender recollections, are we to ascribe that painful longing and deep despondency to which the Swiss and other nations are liable when they have been long absent from their country and their home. Such being the general disposition of mankind to rest where their lot is cast—such the various and powerful ties by which they are attached to particular spots—and so general their aversion to change, we may fairly conclude, when we see the inhabitants of any country eagerly engaging in projects of emigration, in opposition to their natural attachment to their native land, and in defiance of all the uncertainty and peril of a new settlement on a distant and unknown shore, that their conduct is not the result of choice but of necessity, and that, in thus leaving their kindred and their country, they are flying from the pressure of some great and general misery.

General View of the Subject as connected with the Principle of Population.

The great and radical evil which afflicts society is the want of food, which necessarily arises from the tendency of mankind to increase faster than the means of subsistence can be provided. The importance of this great law of nature, under which the want of food is every where found to be the grand obstacle to the multiplication of the species, was first duly appreciated by Mr Malthus, who, in his profound and invaluable work *On Population*, has explained and enforced the principle with such elementary clearness and force, and with such various and

striking illustrations, that it is now universally adopted as an indisputable maxim of political science.

According to the simple view of this interesting subject, contained in the work of Mr Malthus, it has been ascertained, from the history of the American and other newly settled colonies, that where there is abundance of food the population has been doubled in some cases in twenty-five, in others in fifteen years; and it is obvious that if 10,000, or any other number of inhabitants can be doubled within fifteen or twenty-five years, 20,000, or 100,000, or any greater number, may be doubled in the same period with equal facility. The increase of population takes place, therefore, according to a geometrical ratio; every successive addition affording the means of a still greater increase, until the earth being at length replenished with inhabitants, room and food are alike wanting for any farther addition to the human species.

It is not easy to determine the rate according to which the productions of the earth may be supposed to increase. This will in a great measure depend on accidental circumstances. Where there are extensive tracts of fertile and unoccupied land, food will be produced in great abundance; but after these are all cultivated, and the less fertile parts of the country begin to be settled by its increasing inhabitants, subsistence will be produced at a slower rate, and with greater toil. In this manner we find the population continues to advance according to an accelerated process, the increase of one period only affording the means of a still greater increase during the next, and this without any limit; while the subsistence for this rapidly increasing population, in place of being produced with the same facility, in place of increasing in proportion to the growing wants of the community, is necessarily produced at a slower rate, and with greater toil, at the period when it is most wanted. While the principle of population is yet in full vigour, and is every day acquiring new powers of increase, the produce of the earth is daily procured with greater difficulty. The same causes, therefore, which occasion a continual multiplication of inhabitants, prevent any progressive increase in the supply of provisions. By a long process of skilful cultivation, the earth may at last reach the utmost limits of its productive powers. This state of things, it is supposed, has already taken place in China. No efforts of human industry, however judiciously directed, could ever probably double the produce of this highly cultivated country. But the population could still be doubled in fifteen or twenty years with the same facility as before. All countries which have been long settled and cultivated, are in some measure in a similar condition. No efforts of human skill could possibly draw from Great Britain double its present produce within the period during which its population could be doubled, and in all such countries, therefore, the farther increase of inhabitants is checked by the want of food. It is manifest, indeed, that the number of people in any country, or in the world at large, must be limited by the quantity of subsistence provided for their support.

But though it is certain that the population of every country must be kept within the limits of its food, this object may be accomplished by the operation of two different causes. *1st*, General habits of refinement, or prudential motives, such as the fear of bringing children into existence without the means of supporting them, may so far operate on the minds of the labouring classes as to discourage marriage; in which case no superfluous inhabitants will be produced, and the supply of food, though it will admit of no increase, will still be sufficient for the maintenance of the population already in existence. Where the want of food operates in this manner to check the progress of population, Mr Malthus distinguishes it by the appellation of the *preventive* check. *2dly*, So strong, however, is the impulse by which man is prompted to multiply his species, that this preventive check seldom operates with sufficient force to restrain the undue increase of population. In all countries mankind have a perpetual tendency to increase faster than food can be provided, and even when the preventive check operates with most effect, the population frequently presses on the very verge of its subsistence; and is thus exposed, by an accidental failure in the ordinary supply of food, to all the miseries of want. As the number of inhabitants is necessarily restricted by the supply of subsistence, it is certain that, if the population increases beyond this limit, it will speedily be brought down to the level of its food by the operation of famine and disease, which Mr Malthus terms the *positive* in opposition to the *preventive* checks to population.

From this view then of the natural and immutable condition of human society, the want of subsistence seems to be a necessary and an inherent evil, under every form of it; to avoid which, mankind, as they begin to increase, are forced to separate in quest of new settlements, in which, the inhabitants being fewer, food is more easily procured. The want of subsistence is therefore the universal and constant cause of emigration, which forces mankind to disperse themselves, and to explore the world for a more desirable abode. It is no love of change or of adventure which prompts them to wander into unfrequented parts. It is the urgent pressure arising from an overcrowded population which impels them from their homes, which breaks the ties of kindred, and forces them to encounter all the hardships and dangers of new and untried scenes. Where a community is happy and prosperous, mankind will follow their natural propensity to settlement and rest; and it is only when this principle is disturbed by an opposite and equally powerful principle, namely, the fear or the actual experience of want, that emigration will be resorted to, as the least of two evils, not from choice but from necessity. It is under the influence of this great law of nature, namely, the tendency of mankind to increase faster than food can be provided for them, that the earth has been overspread with inhabitants. From the original seats of population and improvement, the human race would naturally overflow into other parts. The regions which were most desirable from their happier soil and climate would be first occupied; these being replenished with people, the overflowing stream would naturally reach the less habitable parts; until at length the frozen regions of

the north and the burning climes of the south would be fully peopled, in proportion to the scanty subsistence to be drawn from them, by an unskilful and barbarous race.

The earth being in this manner filled with people, and no more vacant space remaining for new emigrations, the great check to population, from the want of subsistence, must now be felt in all its force; and it is evident that no farther increase of inhabitants can take place, unless new modes of subsistence be contrived, by which a greater supply of food may be derived from the same extent of territory. The most primitive and barbarous mode of life ever found to prevail among mankind, is, when they depend for subsistence on hunting and fishing, or on a casual supply of such produce as the earth spontaneously yields. From the humble and degraded condition of hunters, they gradually emerge into that of shepherds, and while their flocks and herds afford them a more certain provision, the care of these necessarily calls forth a greater degree of foresight than belongs to the hunting tribes, and the community being also in possession of a stock for their immediate subsistence, are, in every respect, in a superior condition to mere savages. It is in the agricultural state in which a community, adopting all the most ingenious and successful modes of cultivation, and improving, at the same time, in all the arts of commerce and industry, gradually accumulates capital and acquires habits of luxury and refinement, that the earth supports the greatest number of inhabitants, and to this state, therefore, mankind, impelled to improvement by the stimulus of necessity, continually tend. But as the course of improvement is retarded by a variety of causes, it has always happened that, in the general population of the world, three classes have been comprised, who, though variously modified, may be distinguished into those of hunters, shepherds, and agriculturists. When the earth is wholly occupied with these different communities, in each of which the population, according to the great law by which it increases, will soon reach the utmost limit of its food, it is manifest that the great standing cause of emigration will be in constant operation, and in this case there is little doubt that numbers will incur the risks of a removal for the sake of improving their condition.

The inhabitants of a country may emigrate individually, in which case they will be incorporated with the new community into which they enter, and their settlement will be made without violence; or a whole nation may emigrate, with a view of making their way to new settlements by the sword, and of driving out by force the inhabitants of the territory into which their irruption is made. Among civilized nations it is scarcely possible that this mode of emigration can take place. No government would countenance its subjects in any predatory irruption on the territory of another state; neither would the wealth acquired by civilized communities, nor the habits of order, industry, and peace, which wealth necessarily superinduces, at all consist with any such hostile enterprises against the repose of other nations. In an advanced state of society, therefore, the licence of emigration is, in some degree, restrained; mankind emigrate individually, but not in large bodies, and in this manner they are quietly absorbed in the new communities into which they enter, and to the laws and manners of which they necessarily conform. But though the civilized communities of the world never violently emigrate into each other's territories, they frequently invade the domain of the savage, by obtruding new settlers on his uncultivated territories. These emigrating in considerable bodies, and being provided with every necessary implement either of cultivation or of war, take possession of the soil, which they cultivate for their support, and, gradually increasing in proportion as their improved modes of cultivation draw an increased produce from the soil, all the efforts of the original proprietors to dislodge them are found unavailing. From such small beginnings it is that, in modern times, all the flourishing communities of the new world have had their origin.

Among the barbarous nations of hunters and shepherds, emigration necessarily assumes the character of violence. The earth being already occupied with inhabitants, it is manifest that no large body of emigrants can effect a settlement in any territory without displacing an equal proportion of the original inhabitants. These, however, will not yield without a struggle; wars naturally commence, which are carried on with an inveteracy suited to the important object at stake; and while the conqueror occupies the vacant ground, the world is thinned of its superfluous inhabitants in these contests for room and food.

The want of subsistence, which thus excites in mankind a restlessness and an impatience of their condition, and finally impels them to emigration, appears, from the experience of all history, to be a most fruitful cause of war; and, in these struggles, the mere savage has little chance against the more formidable violence either of the pastoral tribes, or of civilized communities. By the first he is driven from his ground whenever it can be occupied with advantage for the purposes of pasture; while the civilized inhabitants of the globe occupy his territories with new settlers, who, spreading cultivation over the desert, and establishing towns with all their refinements of arts and manufactures where there was formerly a wilderness, destroy the hunting-grounds of the savage, and expel him with the wild beasts, his natural prey, from these seats of industry. Thus driven farther into the woods, he is reduced to fight for his subsistence with other tribes in the same condition as himself, and with whom he has more chance of waging an equal war. Room and subsistence being indispensable to the farther multiplication of the species, every combined movement among mankind in quest of these objects is the signal of discord; the savage tribes, confined to the more remote and unfrequented parts of the earth, mutually exterminate each other by their constant and ferocious hostility; and the pastoral nations carry on equally destructive contests with each other, or with more civilized communities. Barbarism and civilization are in this manner the natural enemies of each other; and a most inveterate war is the inevitable consequence of this

hostility. On the issue of the contest, the very existence of both parties is staked. To the vanquished, nothing remains but to perish by famine or the destroying sword. If the barbarous invaders prevail, all traces of civilization are swept away —the form of society is changed—its institutions destroyed, and the nation itself reduced under the most degrading bondage. If, on the other hand, the barbarians are repelled, they have no refuge from destruction. There is no alternative between victory and death, and thus both parties mutually fight with the fury of desperation. But, where the resources of a civilized state are vigorously called forth for the common safety, those formidable inroads will be generally repelled, and the country saved from the ignominy of a barbarian yoke.

Emigrations by which the Roman Empire was overthrown.

To this principle, namely, the disproportion between the increase of subsistence and of population, we may trace that spirit of emigration and of conquest which prevailed universally among all the pastoral nations of the ancient world. The character and manners of those rude tribes has been powerfully delineated by the eloquent historian of the Roman Empire; and Mr Malthus has added a fine historical sketch of the rise and progress of those emigrations which, after a long train of political convulsions, terminated at length in the subversion of the Roman power. It appears, that all that vast portion of the earth, from the Danube and the shores of the Baltic to the confines of China, was formerly occupied by a population of shepherds. These, though distinguished into separate nations, possessing a strong principle of unity in the common tie of their congenial manners, easily coalesced under an enterprising leader for any scheme of emigration or conquest. Deriving their subsistence from pasture and the chace, their ordinary life was one of constant migration, in which they were inured to fatigue, and instructed in the use of all warlike weapons; they were skilful horsemen—expert in archery and in throwing the lance, and extremely active in all their movements. In this wide ocean of barbarism, the stream of emigration was either impelled eastward, as accidental circumstances directed, against the flourishing empires of Asia, or westward against the Roman empire, within whose precincts the whole civilization of the western world was comprised, and alternately, as it reached either of these empires, their whole collected strength was found necessary to withstand the shock. Of the great empires of Asia some were subverted by the formidable inroads of those wandering tribes; and in Europe, the doubtful balance of the world's destiny frequently trembled between barbarism and civilization. At an early period, Rome was assailed by the inroads of the barbarians, and an irruption of the Gauls had well nigh crushed her rising power. In after times, the Cimbri, emigrating in quest of new settlements, were, after they had destroyed five consular armies, arrested in their victorious career by Marius, when the whole nation almost was exterminated. The subsequent contests of Julius Cæsar, of Drusus, Tiberius, and Germanicus, with the Gauls and Germans, still attested the superiority of the Roman arms, and impressed upon the barbarians a salutary terror of the Roman name. Repelled from the Roman frontier, their superfluous resources would naturally be consumed in intestine wars with each other for room and subsistence, until the power of population renewing the strength of those warlike communities, prepared them for fresh conflicts with the civilized world. Accordingly, we find them, in the decline of the empire, renewing their irruptions on the Roman territory. During the successive administration of a series of feeble princes, the empire was assailed by new swarms, and the degenerate Romans had recourse to the dangerous policy of bribing the enemy whom they could no longer conquer. This fatal disclosure of wealth and weakness soon excited the cupidity of new enemies, who broke through the ill-guarded frontier, and spread terror to the gates of Rome. The country became one universal scene of rapine and oppression, and it was only by the vigour and activity of Aurelian, Probus, and Diocletian, that the tottering empire was saved from its final overthrow. During this interval, the barbarians wasted their population in bloody hostilities with each other, until nature, more powerful to renovate than war to destroy, recruiting their numbers, enabled them to set out on new emigrations, with undiminished strength. During the reign of Constantine, the whole power of the empire was again called forth to repel a new invasion of those destroying hordes. They were vanquished on every side, and driven into the mountains, where it is calculated that about 100,000 of them perished from cold and famine. Other invaders now arose, who were routed and dispersed with great slaughter by the warlike Julian, and pursued into the gloomy recesses of the German forests; but those signal successes obtained for the declining empire no relief from incessant attacks, and the reign of Valentinian was one continued contest with the invading hosts. "The fate of Rome," Mr Malthus observes, "was at length determined by an irresistible emigration of the Huns, from the east and north, which precipitated on the empire the whole body of the Goths;" and the nations of Germany, goaded on by this powerful impulse, were driven, *en masse*, on the Roman provinces. "An emigration," Mr Malthus continues, "of 400,000 persons issued from the same coast of the Baltic which had poured forth the myriads of Cimbri and Teutones during the vigour of the republic. When this host was destroyed by war and famine, other adventurers succeeded. The Suevi, the Vandals, the Alani, the Burgundians, passed the Rhine never more to retreat. The conquerors who first settled were expelled or exterminated by new invaders. Clouds of barbarians seemed to collect from all parts of the northern hemisphere. Gathering fresh darkness and terror as they rolled on, the congregated bodies at length obscured the sun of Italy, and sunk the western world in night."

So long as such an extensive space of Europe and Asia was occupied by these pastoral tribes, the repose of the civilized world was constantly assailed by their barbarous invasions; and, in the course of their various expeditions, the finest countries of Europe were taken possession of and plundered. The same principle of increase, which was the ori-

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ginal cause of all these movements, still continued to operate with undiminished force; but while the central countries of Europe remained in possession of their recent conquerors, there was little chance of easily wresting from them what they had so hardly won; and the spirit of emigration being therefore checked and confined for a time within narrower limits by land, the barbarous nations of the north found vent for their overflowing numbers by sea. During the distractions which ensued in Europe subsequent to the reign of Charlemagne, their maritime enterprises were prosecuted with great vigour, and they spread their devastations over Lower Saxony, Friezland, Holland, Flanders, &c. They ravaged the coasts of France, pillaging and burning her finest towns, and at length obtained possession of some of her finest provinces. The British isles were for 200 years exposed to their ravages; and, during the eighth, ninth, and tenth centuries, their plundering expeditions were directed against all the most powerful nations in Europe, until at length the improving powers of these countries, developed by civilization, and directed by policy, were found sufficient to repel all such irregular inroads. It was in this manner the growing strength of the European states, that laid the foundation for that important change of manners among the northern nations, under the influence of which habits of emigration and plunder has been superseded by the peaceful pursuits of agriculture. From this period, the repose of the civilized world has never been seriously endangered by the migrations of any barbarous nation; and it is not likely that such contests will ever be renewed. The pastoral tribes were formidable from the vast space over which they were allowed to range. They are now reduced within much narrower limits. Most of them have been reclaimed from their rude habits and trained to industry. What has been thus lost to savage life has been gained by civilization. The resources of the one have been increased as those of the other have diminished. It does not appear, therefore, from the present aspect of the world, that civilized man has any farther injustice to dread from his savage brethren. These views are eloquently enforced by Gibbon, in the philosophical and striking view of the leading causes which conduced to the fall of the western empire, with which he closes his history. "Such formidable emigrations," he observes, "can no longer issue from the North; and the long repose, which has been imputed to the decrease of population, is the happy consequence of the progress of arts and agriculture. Instead of some rude villages, thinly scattered among its woods and morasses, Germany now produces a list of two thousand three hundred walled towns; the Christian kingdoms of Denmark, Sweden, and Poland, have been successively established; and the Hanse merchants, with the Teutonic knights, have extended their colonies along the coast of the Baltic, as far as the Gulf of Finland. From the Gulf of Finland to the eastern ocean, Russia now assumes the form of a powerful and civilized empire. The plough, the loom, and the forge, are introduced on the banks of the Volga, the Oby, and the Lena; and the fiercest of the Tartar hordes have been taught to tremble and obey. The reign of independent barbarism is now contracted to a narrow span; and the remnant of Calmucks or Uzbecks, whose forces may be almost numbered, cannot seriously excite the apprehensions of the great republic of Europe."

Character of the more Modern Emigrations.

In modern times, since the progress of improvement has restrained the licence of those rude tribes, the spirit of emigration and conquest has chiefly appeared among the civilized inhabitants of the world, by whose encroachments the barbarous nations have been oppressed. The discovery of the immense continent of America, which was chiefly overspread with savage tribes, or with nations in the infancy of improvement, presented a vast outlet to the overflowing population of civilized Europe, and the reputed wealth of those newly discovered countries, which were found to contain abundance of the precious metals, soon attracted crowds of adventurers from every quarter. The first expeditions of the Spaniards to the New World were for the undisguised purposes of rapine and conquest. They were purely military, not so much with a view to settlement as to plunder; and it was only after the first race of adventurers had perished that the emigrants began to establish themselves permanently in the country. With this view they resorted to such measures of violence and cruelty, that, in most cases, they either extirpated the original inhabitants, or brought them under the most galling bondage, and in those parts of the country where they fled into the deserts beyond the reach of their oppressors, and where they subsist in savage independence, the cruel injuries which they originally suffered is still attested in their inveterate hostility to the Spanish settlers. The settlements of the European states in North America were not planned upon exactly the same principles of open violence. The savage tribes, by which this portion of the continent was inhabited, presented no such temptations to the avarice of civilized nations, and the first emigrants who were sent out had nothing else in view but to cultivate the country for their subsistence. Agriculture and not conquest was their original object. They offered no violence to the native tribes. All they required was a space of unoccupied territory on which to settle, which was generally procured without any difficulty. But, as the colony grew and flourished, and began to require an extension of territory, the rude inhabitants of the country quickly perceived that they would soon be dispossessed of their hunting-grounds by the gradual increase of the new settlers. They had committed the capital error of allowing the colonists to take root in the country, and they now endeavoured to correct this error, when it was too late. They accordingly entered into combinations for the purpose of exterminating the invaders of their country, and those infant establishments were alternately assailed by secret treachery or open violence. An equally inveterate warfare was in this manner begun with those who settled for the purposes of agriculture, as with those who had commenced their career with open violence, and the object of contest was the possession of the country. From the rapid multiplication of the new settlers, it was obvious that

Emigration. the land would be speedily overspread with their increasing numbers, and the whole being converted to the purposes of agriculture, there would be no room for the hunting tribes. This was the plain and obvious principle of the war which was now commenced. But the issue of a contest between the civilized inhabitants of the globe, assisted by the modern improvement of fire-arms, and the mere hunter of the desert, could not be for a moment doubtful. The arts and policy of Europe accordingly proved too powerful for the Indian savage. He has been gradually pushed back, by the progress of the European colonies, into his native deserts; and though he has occasionally disturbed their progress by his predatory inroads, yet the inveterate warfare in most cases subsisting between the aborigines and the new settlers, by saving all perplexing or fruitless negociations respecting the cession of territory, and by reducing the matter to the plain issue of force, has, upon the whole, favoured the progress of the civilized encroacher on the territory of the savage. The war of extermination which was commenced between the two classes was sure to end in the destruction of the native inhabitants. A quicker process, indeed, could scarcely have been devised for clearing the country of its barbarous incumbrances; and, however cruel and unjust this may appear, such are unquestionably the harsh means by which the improvement of the North American continent has been brought about. The poor savage has been driven from his territory and his home to make way for the industrious tiller of the ground. The boundaries of the wilderness have been gradually narrowed by the progress of cultivation,—the country has been cleared of its forests and of its inhabitants by the same merciless process of destruction; and upon the ruins of this state of society the system of social improvement has been reared. To the doubtful frontier of the American territory, where civilized gives place to savage life, it is well known, that crowds of adventurous emigrants resort, dispensing with the advantages and exempted from all the restraints of social life. Here they act in the double capacity of cultivators and huntsmen, partly civilized and partly savage, until, by the advance of new emigrants, they are gradually surrounded with improvement on every side, and are at length brought within the pale of order and law. Tired of this control, and anxious to resume their free and licentious habits, they dispose of their lands to emigrants of a more settled character, and again take their station on the verge of the desert, there to bear the brunt of savage hostility, to hunt and to cultivate, and by their resolute and ferocious habits, to repress the inroads of the exasperated Indians, and to act the part of successful pioneers, in clearing the way for the great mass of the American population. It is in this manner that the country gradually assumes the aspect of civilization—that the fields are cultivated, and that the dwellings of men are seen to take place of the haunts of wild beasts. It is certain, indeed, that the policy of the American government, in regard to the native tribes, has uniformly been humane and enlightened; their original right of occupancy has always been respected, and the cession of their territory has generally been procured in lieu of some satisfactory equivalent offered and received. But the licentiousness and cruelties under which the Indians have been oppressed were committed by individuals beyond the precincts of law or government—they were besides glossed over under the specious disguise of legitimate hostility; and there was no one to plead the cause of the oppressed Indians. In these circumstances, the power of government could be exerted with little effect in favour of the native tribes; and, accordingly, it is matter of history that many of the finest parts of the American territory were with difficulty wrested from their original possessors, after a most severe and sanguinary struggle.

America, the great outlet to Emigration.

In its present condition, America presents a grand outlet to the surplus population of Europe. It is the natural asylum of all those who are flying in quest of subsistence from the over-crowded communities of the old world. The inhabitants of America have before them an untouched and fertile country, about 2000 miles in extent (counting from their most remote settlements to the Pacific Ocean), in which for centuries to come their population will have full scope to expand. Here there is an ample supply of fertile and unoccupied land, which yields abundance of food, while its cultivation gives rise to a constant demand for new labourers. Wages are consequently high, the labourer lives in comfort; and if he is industrious, he becomes in his turn a purchaser of land, from the savings which he accumulates. If, from the rapid increase of population, the demand for labour should be satisfied, and wages should fall, this is the signal for new emigrations, and for the occupation of an additional portion of the uncultivated territory; and thus the abundance of land, and the constant demand for labour in the western districts, maintains it at a high price in every part of the United States. In these circumstances, it is manifest that a labourer, provided he can transport his labour from the overstocked market of Europe to the understocked market of America, will dispose of it to better advantage. He will unquestionably improve his condition if he can but once reach this advantageous market for his labour. But if he is already sinking under the miseries of his condition in Europe, the expence of a voyage to America, and even if this could be borne, the farther expence of a long journey inland, before he reaches the western provinces, forms, in most cases, an insuperable bar to his emigration; and, if the attempt is made with insufficient means, it becomes an extremely hazardous experiment, and may ultimately increase, in place of alleviating, the miseries of the emigrant. That the inland states of America afford extraordinary encouragement to labourers, is a point established beyond all dispute; but the difficulty still remains of reaching this desirable country; and to this, which is the important question, the attention of emigrants should be directed. It is their business to reflect, not merely whether it would be desirable to reach America, but whether they have the means of transporting themselves to so great a distance.

Difficulties and Hazards attending Emigration.

Besides those in the condition of labourers, there is another class of adventurers, to whom emigration to the western states of America presents a

Emigration. favourable chance of improving their condition. These are farmers with a moderate capital. An allotment of land may be purchased in the unsettled parts of the country, at the government price of two dollars *per* acre; and an emigrant who can afford to buy and to cultivate 100 or 200 acres, and acts with due discretion and skill, may not only promise himself a sure asylum from want, but, in the course of a few years, the country being settled all around him, and his property rapidly improving in value, he will realize an independent provision for himself and family. A removal to America, however, like every other important step in human life, should be gone about with caution; it should be undertaken, not upon any romantic fancies of ideal happiness, which are sure to be disappointed, but on sober calculations of prudence. Consequences must be coolly considered—opposite inconveniences deliberately balanced—sanguine expectations must be tried by the test of experience—fancy must give place to reality, and what is calmly planned must be vigorously executed. It is only in this manner, when emigration is deliberately chosen, that it promises to be a beneficial measure; and, even in this case, there are many difficulties and discouragements which the emigrant will have to encounter. These consist chiefly in the difficulty of effecting a settlement, and of subsisting until the land yields its first produce—in the herculean labour of clearing ground which is covered with a thick forest—in the danger to a European constitution from the laborious drudgery of felling trees, and afterwards pursuing game in the woods for a scanty subsistence, during which the exhausted body is exposed to the cold dews of night—and finally, in the unhealthiness of the country in the vicinity of the navigable rivers, where the choicest land is chiefly to be found. All these disadvantages and dangers should enter into the estimate of the emigrant, that, when they occur, they may be resolutely met. From the concurring accounts of all those who have lately visited the United States, it appears that no other class, excepting country labourers, mechanics, and farmers, could be at all certain of improving their condition by emigration. There may occasionally be a favourable opening for the employment of capital in manufactures or in commerce; but opportunities of this sort cannot be reasonably calculated on by those who are at a distance; and emigration with any such views would be a rash and highly ineligible experiment. In the American community, there are no vacancies for professional men of any description.

Emigrations from the Highlands of Scotland.

It has been already stated, that the great cause of emigration is the want of subsistence, and that where a community is prosperous and happy, mankind will follow their natural propensity to settlement and rest. But this general cause is frequently aided by other causes, originating in those changes of manners, to which the progress of society is constantly giving rise. In consequence of that great revolution which took place in modern manners, when the feudal system was superseded in Europe by the progress of commerce and industry, the numerous retainers of the great landed proprietors were thrown loose upon society, and reduced to quit their former abodes in quest of a new settlement. Prior to the improvement of industry, there was no way in which the proprietors of the soil could consume their surplus produce, but in maintaining a retinue of idle dependants, who repaid, by their fidelity in war, the bounty on which they subsisted during peace. No equivalent existed for which they would exchange their revenues, which were accordingly wasted in the most profuse hospitality, and in these times a train of idle retainers was the never-failing appendage of wealth and greatness. But when commerce and industry began to supply the landed proprietors with a new equivalent in which their surplus produce could be expended, their idle retainers were gradually dismissed, and the surplus produce of the soil, by which they were supported, was now laid out by the landlord in expensive luxuries and refinements. In the more improved parts of the country, all those changes have already taken place. The land is invariably let for the highest rent that can be procured, and the superfluous population from which it has been freed is absorbed in the general mass of society. But, in the Highlands of Scotland, these changes are not yet fully accomplished. Traces are still to be discerned of that ancient state of manners which was formerly prevalent all over the country, but which are now fast disappearing before the progress of improved cultivation. Until about the year 1745, the landed estates in the Highlands of Scotland were occupied by tenants, who paid for the possession of the land rather in military services than in money; and though, after this period, these services were of little use to the proprietors, yet from habit, and the influence of old attachments, the tenantry were still continued on their lands. The obvious interest of the proprietor in letting his lands to the best advantage has gradually broke the force of these old feudal connections, and the hereditary occupants of the Highland estates are now ejected by the landlord, to make way for a more improved mode of cultivation, and for more profitable tenants. Under the old system, as many inhabitants were settled on the land as it could maintain; under the new system, no more hands are maintained on it than can be profitably employed; and the superfluous labourers or tenants, who are thus removed from the spot which their families have possessed for centuries, naturally turn their views to America, where there are boundless tracts of unoccupied land ready to receive them. Their early habits and mode of life entirely disqualify them for mercantile business. Ejected from their hereditary possessions, they are in a manner outcasts in their native land, and, in search of some new place of rest, they voluntarily quit their kindred and their home. Lord Selkirk, in his able publication *On the State of the Highlands of Scotland*, points out the strong motives which prompt the Scotch Highlander to emigration, in preference to settling at home as a day-labourer or a manufacturer. "The manners of a town," he observes, "the practice of sedentary labour under the roof of a manufactory, present to the Highlander a most irksome contrast to his former life. The independence and irregularity to which he is accustomed, approach to

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that of the savage: his activity is occasionally called forth to the utmost stretch, in conducting his boat through boisterous waves, or in traversing the wildest mountains amidst the storms of winter. But these efforts are succeeded by intervals of indolence equally extreme. He is accustomed to occasional exertions of agricultural labour, but without any habits of regular and steady industry; and he has not the least experience of sedentary employments, for which, most frequently, the prejudices of his infancy have taught him to entertain a contempt."

The emigrations from the Highlands of Scotland have always kept pace with the progress of improvement, and, from about the year 1773, they have been continued with little intermission. Of all those who were thus compelled to quit their native land, America became the natural asylum; and to different points of this extensive continent they were attracted by circumstances in a great measure accidental. The first emigrations were undertaken under all the disadvantages and anxiety of imperfect information. But these having succeeded, a more secure foundation was laid for future enterprises of the same nature; and the Highlanders, who were disposed to emigrate, naturally chose the spot where their friends were already settled. In this way, they are scattered throughout different parts of the American continent. Some have formed settlements in the state of New York, on the Delaware, the Mohawk, and the Connecticut, while others have gone to Georgia and to North Carolina, or to the more northerly climate of Canada and Nova Scotia. Their choice of a settlement appears to have been dictated by the natural wish of being near their friends, by whose experience and advice they would be assisted through all the difficulties of a first establishment. A mode of conduct more rational, more calculated for social comfort and for ultimate success, can scarcely be imagined; and if the interest of the emigrant had been alone considered, no other plan would ever have been adopted.

Observations on Lord Selkirk's Plan.

In the emigrations planned by Lord Selkirk, other views were, however, mingled with the original and simple purpose of these expeditions. In place of assisting the Highlanders in their own natural and rational plan of joining their friends already settled on the other side of the Atlantic, his purpose, as he himself states, was to detach them from those natural ties; to counteract the motives which induced them to follow their friends and relations; and to collect them into a new settlement, under the dominion of the mother country. After pointing out the strong inducements which the emigrants have to collect in particular spots, to which the presence of their friends and connections impart the attraction almost of another home, he observes, that, to overcome these motives, it is indispensable that "some strong inducement should be held out to the first party, who will settle in the situation offered to them. To detached individuals," he continues, "it would be difficult to offer advantages sufficient to counterbalance the pleasure of being settled among friends, as well as the assistance they might expect from relations. But a considerable body of people, connected by the ties of blood and friendship, may have less aversion to try a new situation." Lord Selkirk objects to emigration, where the adventurers are allowed to follow their own notions, and settle in detached bodies in different parts of the American territory, because it scatters the national resources, which he proposes to keep together, by inducing the emigrants to settle in the British colonies, "where," he observes, "they would be of national utility," and where all the peculiarities of their language and manners might be preserved. He seems also to imagine, that, if the Highlanders were settled on the Canadian frontier, they would form an admirable outpost to guard the colony from the intrusion of American settlers, and from the worse plague of American principles, of which he entertains a great dread, and against which he considers the inveterate loyalty of the Highlanders as an admirable barrier. In pursuance of those views, a colony of Highlanders was induced, by Lord Selkirk, to settle in Prince Edward's Island, in the Gulf of St Lawrence, where an establishment was formed, and where, in the course of about two years, a supply of subsistence was produced equal to the wants of the settlers. Another colony was afterwards conducted to the western parts of Upper Canada. Of the progress of this colony, different and contradictory accounts have been circulated. Thus far, we believe, however, is certain, that Lord Selkirk's projects gave rise from the first to a deep-rooted jealousy on the part of the *North-west Canadian Fur Company*; and that, after various acts of hostility and sanguinary outrage, the settlement was attacked by a body of their servants, who barbarously put to the sword the greater part of the settlers, and nearly extirpated the colony. From this calamity it is said to have revived, and, from the accession of new settlers, its inhabitants are reported to amount to about 500.

To the plans of emigration, set on foot by Lord Selkirk, there is this strong and general objection, that they propose to accomplish objects, in which the emigrant has not the most remote interest, and for which all the comfort, as well as the solid advantages which he would derive from the intercourse of his relations and friends, are uselessly sacrificed. The sole purpose for which he quits his country, is to procure a settlement in another on the most easy and advantageous terms; this is his only motive for embarking in so hazardous an enterprise; and whatever is unconnected with his ultimate prosperity and happiness, is entirely foreign to the main object of his voyage. To settle among friends and relations, whose comfort and assistance is material to the emigrant, or in a country which has the benefit of a free and enlightened government, where he is sure of protection, and where, as much as possible, he may have all the helps of civilization to facilitate his progress, is wise and rational; and there is something unnatural, as well as revolting, in the notion of extinguishing all those social feelings, which bind the emigrant to his friends and relations, and which revive, even on a foreign shore, the image of his native land. According to Lord Selkirk's plan, the emigrant is deprived of all those consolations; and he is tempted to try a new situation, for the vague and chimerical purpose of concen-

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trating, for the benefit of the mother country, resources which would be otherwise scattered; or for the still more chimerical purpose of guarding the Canadian frontier from the inroad of American principles. These are political objects in which the emigrant has not the most remote interest. Formerly, the emigrants from the Highlands had almost the whole continent of North America open to their choice. They could settle among their countrymen and relations, amid the blessings of civilization and of regular government. According to Lord Selkirk's plan, they are thrown upon precisely the very worst portion of the American continent—withdrawn from the more genial climes of the South—exposed to the long rigours of a Canadian winter, and separated from their friends. The first body of emigrants, who accompanied Lord Selkirk, were settled on an island in the Gulf of St Lawrence, in a desolate spot, thirty miles from any habitation, "in circumstances scarcely more favourable," as he himself observes, "than if the island had been completely desert." His second colony was established on the continent, far to the westward of any settlement, and wholly without the precincts of civilization or regular government. It was accordingly either altogether or nearly crushed by violence; and this fatal catastrophe is a suitable commentary on the original impolicy of chusing the desert for a settlement, and of relinquishing the protection of government, with all the other advantages of a more improved state of society. The happiness and comfort of the colonists, which is the fundamental principle of all colonization, was made subservient, in those plans, to other objects, in the highest degree absurd and chimerical; other interests were allowed to mingle with that great and radical interest; and useless hazards were incurred,—hazards which were avoided so long as the emigrants were allowed to follow the sure and unerring instincts of their own individual prudence.

Controversies and Laws respecting Emigration.

The emigrations to America, which were formerly confined to the Highlands of Scotland, or to some parts of Ireland, have of late years become general throughout the kingdom. The cause has been, as usual, a want of subsistence, originating in the want of employment for the labouring classes. The wars and devastations which had prevailed in Europe for about twenty-five years prior to the last peace,—the unprecedented acrimony of the hostilities waged by the different belligerents against each other's trade,—the interruption, in consequence, of their commercial intercourse, and a complication of other causes of mischief, into which it is foreign to our present purpose to inquire, though they were long borne up against by the enterprise and industry of individuals, appear to have at length terminated in a complete and general relaxation of all the great springs of the mercantile community. In these circumstances, numbers emigrated to America with various success, artisans and labourers as well as substantial farmers. Among others Mr Birkbeck, an English farmer, having sold his effects, embarked with his family for America, and purchased a large tract of uncultivated territory on the Wabash, a branch of the Ohio. Having formed an establishment in this remote and sequestered spot, he published, for the benefit of such as were disposed for similar enterprises, an account of his journey and subsequent proceedings, in which he sets forth, in glowing colours, all the advantages of emigration. Other publications followed of an opposite tendency, and a controversy was in this manner begun on this important question. That certain classes of persons will improve their condition by a removal to America, cannot be doubted. But it is equally certain, that the emigrant must lay his account with many difficulties and discouragements, and these perhaps Mr Birkbeck has rather thrown into the shade. It must be recollected that he is himself a successful emigrant; perfectly satisfied both with the step he has taken, and with the country; and this disposition of mind, communicating itself to his descriptions, is apt to excite fanciful anticipations, which the event may not realize.

It is singular, that the emigration of inhabitants from one country to another, should, in most cases, be regarded by those who are left behind with the most decided marks of disapprobation. To such length has this spirit been carried, that laws have been passed, obstructing emigration, as if it was an evil; and, with a view of still farther discouraging all such schemes, the most exaggerated accounts have been studiously circulated of the distresses and difficulties in which the poor emigrant involves himself by rashly removing to a foreign land. In the Highlands of Scotland emigration has always been viewed by the landed proprietors with the most extreme jealousy and aversion, although it plainly has its origin in the measures adopted by themselves for the improvement of their own estates. The first step to an improved mode of cultivation is to clear the land of all its useless inhabitants; and the discarded tenants are compelled to seek in a distant land that subsistence which they can no longer find at home. Emigration is the sad alternative which they embrace from necessity; they quit the cherished spot on which their family has been settled for ages, because they can no longer remain, and to refuse them this resource appears both cruel and unreasonable. Under the influence of those prejudices, a law was passed in 1803, for the ostensible purpose of securing to the emigrant good treatment during his voyage, but really with a view, it should seem, of obstructing it altogether. By this law, the most extravagant allowances are prescribed to him both as to room and food, and these he is not at liberty to dispense with. Its effect is consequently to enhance the expence of the voyage, and to obstruct emigration, or, when this consequence does not follow, to waste the stock of the emigrant, by involving him in useless expences, and to land him on a foreign shore with diminished resources. It tends, in this manner, like all the other laws which, in the management of private concerns, officiously substitute loose and inapplicable rules for the prompt sagacity of individual prudence, to injure those whom it is intended to serve. By other laws, emigration, to certain classes, is actually prohibited under severe penalties. An artificer who attempts to emigrate "with the intention of devoting his knowledge for the benefit of foreign countries," is liable to punishment, as well as any agent by whom

he is encouraged to such an attempt; and, upon this very absurd law, two convictions actually took place at the Old Bailey in 1809; the one of a master who had offered an artificer advantageous terms to emigrate to the United States, and the other of the artificer who, having no work at home, had accepted of those terms. It deserves to be remarked, that the judge who tried the case, forsaking his own proper province of merely administering the law, commended highly its policy, and dwelt at great length on the mischievous crime with which the prisoners stood charged, as deservedly and severely punishable by law. It is justly observed by Dr Smith, that the industry of an artificer is his only inheritance, and that to prevent him from disposing of it to the best advantage is an unwarrantable act of power. The object of such regulations is to depress the art and industry of other nations, in order to monopolize for our own industry the market of the world. But this project, which originates in mercantile rivalry of the most pitiful description, is as unjust as it is impolitic. We may indeed prevent, by particular laws, the exportation and importation of certain sorts of produce. But no laws can bind up the inventive powers of man, nor can any partial enactments of particular countries retard the improvement of the world. If the general increase of wealth requires a supply of the finer manufactures, and the proper reward is offered, the art and industry necessary to produce them will be called forth, in spite of the regulations which any one state may pass to the contrary. The law, besides, admits of the following simple evasion: The artificer who intends to emigrate takes his passage as a labourer, and, in this character, he is suffered to depart without farther question.

Although the emigrations which have of late years taken place were manifestly occasioned by the total want of employment and subsistence, owing to the lamentable derangement of commerce, an outcry was, nevertheless, raised against the emigrants by those whom their happier destiny had enabled to remain at home. This is the more extraordinary, seeing that the country is crowded with labourers who cannot find employment, and that it is obvious, that, if there is too little either of subsistence or of employment, the emigration of those who require both to be employed and to be fed, will leave a greater supply for those who remain behind. Wherever there is a greater number of labourers than can be employed,—where wages are consequently low and general distress prevails, emigration is precisely the most effectual remedy for the evil. In proportion as superfluous labourers are withdrawn from the over-crowded communities of Europe, those who are left behind will enter into more full employment and better pay, and will live comfortably in place of starving as before. Whatever may become of the poor emigrants themselves, the country from which they emigrate must be benefited by the quantity of labour thus withdrawn from the market. In place, therefore, of seeking to arrest the progress of emigration, it would be wiser to encourage it, and rather to give facilities to those who wish to convey their labour from Europe, where the market is overstocked, to those countries where there is more demand for it. We are happy to add, that, in pursuance of those maxims, a plan has lately (June 1819) been adopted by the British government for encouraging emigration to the Cape of Good Hope, and that a grant of L. 50,000 has been voted by Parliament, to be laid out in carrying it into effect. A small deposit of money is required from the emigrant before leaving this country, which is returned to him on arriving at the Cape, with all his other expences. (o.)

ENGLAND.

The *History* of this country, from the earliest accounts to the union of the crowns, is given in the *Encyclopædia*, under the article England. It is continued from that period to the rupture of the treaty of Amiens, under the word Britain; and will be brought down, in this Supplement, to the late general pacification and settlement of Europe, under the head of Great Britain. The present article will, therefore, be limited to those inquiries which belong to the *Statistics* of England; but, even in this view, we must leave out such parts of the subject as have been already treated in the *Encyclopædia*, and confine ourselves to the supplying of omissions, and of recent or corrected information.

I.—*Situation, Extent, Face of the Country, Soil, and Climate.*

Situation and Extent. England, the southern, and by far the most fertile division of Britain, is parallel in latitude with Holland and the North of Germany, extending from 50° to 55° 45′ N. Its figure is nearly triangular, and its extent of coast is very great, both from being much indented and from the sea bounding it on all sides, except along a width of seventy miles on the Scottish border. The adjacent seas are the German Ocean on the east, St George's Channel on the west, and the English Channel on the south. No country can be more fortunately situated; its climate is temperate; its extent is sufficient for its political security; while its insular position not only presents the greatest capabilities of aggrandizement in a commercial sense, but has, by rendering a great military force unnecessary, in all probability been the chief cause of preventing the executive branch from usurping absolute power, as in the countries of the Continent.

Its superficial extent had long been a question of considerable doubt, and the different estimates varied no less than ten millions of acres. Mr Pitt,

Situation and Extent.

on the authority of Arthur Young, assumed, in 1798, the superficial extent of England and Wales to be nearly 47,000,000 of acres: a later calculation by Dr Beeke, approaching more to accuracy than any preceding one, fixes it at 38,500,000 acres (*Observations on the Produce of the Income-Tax, &c.* 1800); but a still more recent survey (*Report to Parliament on the Roads in* 1818) declares the area of England and Wales to be only 57,960 statute miles, containing 37,094,400 acres.

Face of the Country.

England is, in general, a level country: in the north, Westmoreland, and a considerable part of Cumberland, Lancashire, and Yorkshire, are mountainous, but most of the other counties of England present a succession rather of picturesque eminences than of great elevations; forming a striking contrast to the barren ridges of the northern part of the island, and still more to the abrupt and awful scenery of Switzerland, or the south of Germany. The highest mountains of England are in the north-west, where there are several exceeding 3000 feet in height; of these the most noted, if not the highest, is Skiddaw. Between Lancashire and Yorkshire, there is a range of nearly equal altitude; in Shropshire there are various hills; also in Somerset, Devon, and Cornwall, none of which, however, reach the height of 2000 feet. There is a long hilly range which traverses the southern counties, in a line nearly due east and west from Dorsetshire to Kent; and another that goes in a north-east course from Wiltshire to the East Riding of York, but both are of inconsiderable elevation. The traveller, who proceeds northward from London to York, meets very few hills and hardly one mountain in a distance of 200 miles. To the east of this road, the country, particularly Cambridgeshire, Lincolnshire, and part of the East Riding of Yorkshire, is almost entirely level, and bears a great resemblance to Holland; consisting of fens apparently gained in a very remote age from the sea. In Wales, the face of the country is altogether different, being mountainous throughout, and some of the hills, in particular Snowdon and Cader Idris, attaining a height nearly 3600 feet above the level of the sea.

Sea Coast.

The sea coast of England presents a very different aspect in different situations: in some quarters, as in Cornwall, in Kent, in part of Norfolk, and in Wales, it is steep and elevated; in other parts it is low, sandy, or marshy; exhibiting, on the whole, a variety which hardly admits of being brought under a uniform description; and which, though partaking much more of a level than rugged character, still differs greatly from the opposite shore of Flanders, Holland, and Friesland, which is one continued flat for more than 300 miles.

Rivers.

Of the rivers of England, the largest are the Thames, the Severn, and the Trent. The Thames has no pretensions to romantic effect in any part of its course, nor is its body of fresh water large; but it is navigable for more than 120 miles, and in the approach to London from the Nore, presents to the admiring spectator a prospect, which, whether we consider the quantity of shipping, the thickening population, or the high state of improvement of its banks, is wholly without parallel. The Severn, though not equal to the Tay in quantity of fresh water, is superior to the Thames, and during the first part of its course preserves the characteristics of a mountain stream, being clear, and at times bordered by picturesque scenery; but on leaving Wales, and entering a more level country, it assumes a different aspect, and becomes a full slow-flowing river, admitting of easy navigation, and facilitating greatly the commerce of Shropshire, Worcestershire, and Gloucestershire. Towards its mouth it receives the Wye, a large navigable river from Wales. The Trent rises in Staffordshire, and after a course, often tortuous, but generally in a north-east direction, falls into the Humber, which soon after becomes a broad estuary. The Mersey, as a river, is of no great importance, but as an arm of the sea it affords, from the west, a very capacious inlet to the trade of Liverpool, and facilitates the conveyance of the produce of the interior. The Tyne is a large stream, having Newcastle on its banks, and Shields near its mouth. The Medway, as a fresh water river, is small and sluggish, but acquires, by the influx of the tide, such a width of channel and such a depth of water at Chatham, as to adapt it to the reception of the largest men of war. Speaking generally, it is only the rivers of Wales, Westmoreland, Cumberland, and a few mountainous districts that are rapid or transparent; the great majority of English rivers, particularly in the eastern and central part of the kingdom, are slow in their course, and owe the degree of beauty they possess, less to the effect of the water or scenery, than to the high cultivation and elegant disposition of the adjacent grounds.

Lakes and Forests.

A similar remark applies to the lakes of England: nothing can exceed the beauty of Winandermere, Keswick, and Ulleswater, while the unvaried and uninteresting collections of water, such as Whittleseameer, and others in the fen district, are to be compared only to those in North Holland or Friesland. In regard to wood, England is very well provided, without having many of those extensive forests which are met with on the Continent on great mountain ranges; such as on the Jura ridge between France and Switzerland, and the Suabian Alps on the Upper Rhine. It is in private plantations of limited extent, but of very frequent occurrence, and sometimes of great beauty, that the chief stock of English timber is to be found. Several extensive tracts, such as the New Forest in Hampshire, the Forest of Dean in Gloucestershire, and Sherwood in Nottinghamshire, belong to the Crown.

Soil and Produce.

The soil of England is suited to a great variety of products; but it has not the exuberant fertility of southern climates; much labour and vigilance being requisite to obtain from it a grateful return. The quantity of moisture makes it admirably adapted to pasture; a characteristic which does not particularly strike those whose travels have never extended beyond their own country; but is of the highest importance in the view of those who have visited the Continent, and have witnessed the parched and arid state of the richest plains in the months of autumn. In regard to husbandry, it happens, by a singular coincidence, that, in England as in Scotland, the best is practised in the east part

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of the island; particularly in Norfolk and Northumberland. As to mineral treasures, the eastern half of England, at least of England to the south of Yorkshire, is remarkable for containing no mines either of coal or of metal; these valuable deposits are to be sought in the more uneven districts of the north and west, viz. in Durham, Westmoreland, Lancashire, Shropshire, Worcestershire, Devon, and Cornwall. In the east, particularly in Lincoln and Cambridgeshire, vast improvements have been made in the present age by draining, but there is still the means of making farther and valuable acquisitions. Much also remains to be done in bringing into culture extensive heaths and moorlands in almost every county in the kingdom; the soil of these is in general poor, but the tillage required would seldom be obstructed, as in many parts of Scotland, by the ruggedness of the surface. Comparing the soil of England with that of the adjacent countries, we find it greatly superior to that of Scotland, except along our eastern coast; it is perhaps better also than that of Ireland, fertile as the latter naturally is; nor needs it, on the whole, dread a comparison with the soil of France, where, amidst districts of great beauty and luxuriance, the eye of the traveller is often struck with extensive tracts of heath or marsh.

The soil of Norfolk is particularly adapted to barley; and the fens of Lincolnshire and the adjacent counties for oats. Leicestershire has long been accounted the first of our grazing counties; Herefordshire takes a lead in orchards; while Surrey and Worcestershire, but above all Kent, are celebrated for hops.

The following table, given by Mr Comber, in his treatise on *National Subsistence*, exhibits the results of a computation of the extent of land under cultivation in England and Wales:

	Acres.
Wheat	3,300,000
Barley and rye . . .	1,000,000
Oats and beans . . .	3,000,000
Clover, rye, grass, &c. .	1,200,000
Roots and cabbage cultivated by the plough . . .	1,200,000
Fallow	2,300,000
Hop-grounds . . .	34,000
Nursery-grounds . . .	9,000
Fruit and kitchen gardens	41,000
Pleasure-grounds . . .	16,000
Land depastured by cattle	17,000,000
Hedgerows, copses, and woods	1,600,000
Ways, water, &c. . . .	1,300,000
Commons and waste lands	5,094,000
Total	37,094,000

The quantity of corn raised *per* acre is, of course, very various, according to the soil; $2\frac{1}{2}$ quarters for wheat, four for barley, and $4\frac{1}{2}$ for oats, may be stated as a fair average return; though any calculation from such data must be very vague, as on some spots the produce of wheat amounts to six quarters, in others to only $1\frac{1}{2}$ quarter *per* acre. The average weight of a bushel of good English wheat is about 58 lbs.; in bad seasons, it does not exceed 56 or 57, but in good years, and in the best wheat districts, it is found to weigh from 60 to 62, and in some particular spots 64 lbs. It yields 43 lbs. flour for standard wheaten bread, or $46\frac{1}{2}$ lbs. for household. The culture of rye in England is now much restricted, compared to what it was in former times; also that of buck-wheat, which, under the name of *Sarrazin*, is so common on the opposite coast of France. The cause of this decrease lies in the preference given by our peasantry to wheaten bread, and in the cultivation of more valuable grain on the land formerly appropriated to the inferior sorts. Of hops, the quantity raised throughout the kingdom is necessarily very fluctuating, but it may be computed at an annual average of twenty millions of lbs.

Climate.

The climate of England is that of an insular country of limited extent, subject, in consequence, to rain, and exempt from intensity of either heat or cold. Compared with the adjacent countries, it is less humid than Ireland, which, like Portugal, in a different latitude, is the first land to intercept the vapours of the Atlantic; on the other hand, the climate of England is less dry than the opposite shores of Holland and Germany, to which every wind but the west arrives across a tract of continent. The climate of the south of England resembles much that of the opposite coast of Brittany, Normandy, and Flanders; while that of the north is very similar to the temperature of Denmark, which, like the north of England, is a narrow country enclosed on either side by the sea. In regard to the relative degrees of heat or cold, if England has not so much summer warmth as continental countries on the same parallel, she generally escapes in winter that intensity of frost, which in less than 48 hours of easterly wind so frequently seals up their harbours. On the other hand, our weather is much more variable than in the inland part of the continent, and our sky less clear; still it by no means follows that the balance of disadvantage is on our side. The moderate heat and frequent returns of rain preserve throughout the year that verdant pasture which, in autumn, the continent enjoys only in its maritime districts; while those droughts in spring, which are so noxious in the south of France and similar latitudes of the continent, are hardly known among us. In point of salubrity also, we may fairly stand a comparison with our neighbours, for, variable as is our atmosphere, perhaps no country exhibits a larger proportion of examples of longevity.

There exists, however, a considerable difference in the climate of different parts of England. The west, exposed to the Atlantic, and containing hills and mountains which intercept the clouds, is much more rainy than the east, where the aspect of the country is level, and the expanse of adjacent water much less considerable. Another, and equally remarkable difference, arises from latitude, the season being a fortnight or three weeks later in the north than in the south of England. Notwithstanding all the skill of the Northumbrian farmers, the traveller who leaves the harvest finished in the south of England in the first week of September, and who sees the corn cut, if not carried, in the midland counties, will generally find it, in the middle of that month, untouched

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and standing in most parts of the country to the northward of York. In winter this difference in the temperature of the North and South of England is less perceptible. As to the spring months, March is, proverbially, raw and cold, from the prevalence of easterly winds, particularly in the part of the kingdom adjacent to the German Ocean: April is, in general, wet and favourable to vegetation, but May, though a pleasant month, can hardly be said with us to bring more "indulgent skies." It is in June, July, and August, that our climate takes a more settled aspect; while, at the same time, the power of taking exercise on almost any day is indicative of a very gratifying advantage over the sultry atmosphere of our southern neighbours on the Continent. November, though frequently wet and foggy, is only a prelude to winter; even December does not often bring intense frost, which is commonly reserved to January; and during the last twenty years we have been repeatedly without any frost of consequence, or heavy falls of snow until a considerable time after the days have lengthened.

Variations of Temperature.

During the six winter months, from October to March, the mean temperature of the central part of England is commonly between 42° and 43° of Fahrenheit. In December, January, and February, it is generally below 40°: In July and August, 62° to 65°. The variations of temperature within the space of 24 hours are felt most strongly in the equinoctial months, March and September. In these there is often a difference of 18° or 20° between the day and night, while, in the summer months, this difference seldom exceeds 12° or 15°, and in December or January, is only from 6° to 8°. The mean annual temperature, noon and night, of the central part of England, is about 50°. The greatest summer heat seldom exceeds 80°, and the cold of December or January is rarely below 20° or 25°. In mild situations in Devonshire and Cornwall, the winter temperature is 2°, 3°, 4°, and even 5° higher than in London. Penzance is the spot in England least visited by severe cold; and it is consequently much recommended in pulmonic cases.

Of rain, the largest proportion falls in the N.W. of England, particularly in Westmoreland and Lancashire, owing to the neighbourhood of the sea and the height of the mountains. There, the average quantity is found to be 45, 50, and, in some situations, 60 inches, while the average of the kingdom at large is from 30 to 40.

Temperature of recent Seasons.

No period has been marked with a more sensible variation of seasons than the last five or six years: the winter of 1813-14 was long and severe; the summer of 1816 cold and wet; the summer of 1818 uncommonly dry and warm. This will at once appear from the state of the thermometer. During the summer of 1815, which may be termed one of medium warmth, the thermometer was at or above 70° during 27 days; in 1816 it rose to 70° in five days only: in 1817, which was also deficient in warmth, it reached or exceeded that limit on 17 days only; but, in 1818, it was at or above 70 during no less than 70 days, and in the three days of greatest heat it was between 83 and 87. In all these instances the case was the same throughout the continent of Europe; the crop of 1816, for some time very promising, became, in a great degree, lost for want of warmth; that of 1818 proved on the Continent as in England, abundant in wheat and scanty in most other grain; while last winter was equally mild, and the summer of this year (1819) was still more forward on the Continent than in Britain.

Prevailing Winds.

The prevalent winds in England are west and south-west. Our outward-bound merchantmen are often detained from the want of a Northerly or Easterly wind, but it rarely happens that our homeward-bound are kept beating in the Channel by the want of a westerly breeze. In these respects, also, the case is the same on the opposite shores of the Continent; the Dutch and French outward-bound vessels often experiencing detention from the continuance of westerly winds.

Divisions.

II.—*Divisions, Civil and Ecclesiastical.*

The civil divisions of England are those of counties, hundreds, and parishes. The county divisions, like several of our national improvements, take date from the reign of Alfred, and though subsequently increased by the acquisition of the three northern counties from the Scots, have not, in other respects, experienced much alteration since his time.

Civil Divisions.

The 12 counties of Wales added to the 40 counties of England make a total of 52. The name of "County corporate" is given to most of the cities of England and to some of the towns; this distinction, little attended to by the public, and seldom mentioned but in law-papers, implies that the district in question is governed by its own sheriffs and other magistrates, to the exclusion of the officers of the county at large.

The division into hundreds must have originated in a reference to the existing population, and have implied a district containing either a hundred able bodied men, or a hundred families. As population increased very differently in different situations, great inequality ensued in regard to these divisions, and, in the reign of Henry VIII., many of the larger hundreds were partitioned into smaller districts. Hundreds were farther subdivided in the time of Alfred into tithings, or associations of ten men, for the purpose of mutual defence. But both these subdivisions were unknown in our northern counties from their not having been subject to the Saxon legislator: these counties, on their subsequent annexation to the crown of England, were divided into "wards" and "wapentakes;" terms sufficiently expressive of the warlike character of the age, and of the exposed situation of a frontier province.

Ecclesiastical Divisions.

The ecclesiastical division of England is into two archbishoprics and twenty-four bishoprics. The archbishopric, or "province" of York, though by much the smaller of the two, comprises Northumberland, Durham, Westmoreland, Cumberland, Cheshire, Lancashire, the chief part of Yorkshire, and the Isle of Man: Canterbury extends over all the rest of the kingdom, including even Jersey and Guernsey. The bishoprics are very different in extent of jurisdiction as well as in annual emolument. The *Encyclopædia* contains a list of the dioceses, and of their respective revenues, as entered in the king's books;

Harbours, Roads, &c.

but their present incomes are greatly increased, in consequence of the rise in the value of land. The third and most familiar of the ecclesiastical divisions of England is into parishes. This mode of division seems to have existed from a very remote period, and to have continued during the last five centuries on the same footing, with very slight variation, as at present. The total number of parishes in England and Wales is 10,674.

III.—*Harbours, Roads, Canals, Bridges.*

Harbours. We have already noticed the great navigable rivers of England. In regard to sea-ports, after London, which is perhaps the most capacious and happily situated in Europe, the principal are Liverpool, Hull, and Bristol. Liverpool and Hull are situate on great inlets of the sea, while Bristol stands on a comparatively small river, and, though long a seat of commerce, is indebted for its present magnitude to recent improvements.

Liverpool gave the first example of wet-docks, originally on a small, afterwards on an extensive, scale. Hull followed the example, her first dock dating from 1774, her second from 1803. Meantime the metropolis opened successively the West India, London, and East India docks; and in 1805, Bristol commenced a great work of the same description. Considerable extensions of the wet-docks of Liverpool and Hull are going on at present. (1819.)

The chief sea-ports of England, after the four just mentioned, are Shields (for Newcastle), Sunderland, Whitby, Scarborough, Grymsby, Lynn, Yarmouth, Harwich, Sheerness, Chatham and Ramsgate, on the east coast; Portsmouth, Southampton, Poole, Weymouth, Dartmouth, Plymouth, and Falmouth, on the south; with Swansea, Milfordhaven, Chester, Lancaster, and Whitehaven on the west. In the English Channel, the depth and capaciousness of a number of harbours on our side form a striking contrast to the French side, where there are only St Maloes, Cherburg, and Havre de Grace, none of which are convenient stations. Our great naval stations, such as Portsmouth, Plymouth, and Chatham, have been already described under DOCK-YARDS.

Roads. It was not until after 1660 that the public took an active part in regard to the highways. Turnpikes were at that time placed on the great North road, in the counties of Hertford, Huntingdon, and Cambridge; but it was not till after the peace of 1748 that adequate exertions were made to redeem our public roads from their wretched state. After 1760, the increasing price of agricultural produce, and the general spirit of improvement, were of the most beneficial operation in this respect; and in the fourteen years from that time to 1774, no less than 452 acts were passed for the amelioration of our roads. It was then also that our inland navigation assumed an aspect of activity. The Bridgewater and Trent canals were begun; yet the number of Canal acts that passed between 1760 and 1774 was only nineteen. The American war interfered considerably with public improvement; and it is only from the date of its cessation that we enter on an active and prosperous era.

Acts of Parliament passed for Public Improvements.

Harbours Roads, &c.

Years.	For Roads and Bridges.	Canals and Harbours.	Inclosing, Draining, and Dividing Land.	Paving and other Local Improvements.	Total for each Year.
1785	31	7	22	20	80
1786	40	4	25	14	83
1787	30	3	19	14	66
1788	37	5	36	14	92
1789	36	6	36	18	96
1790	30	9	27	20	86
1791	44	13	39	20	116
1792	54	17	41	19	131
In 8 years of peace	302	64	245	139	750
1793	62	32	62	15	171
1794	35	22	74	5	136
1795	36	13	80	10	139
1796	27	18	76	8	129
1797	39	14	91	7	151
1798	41	7	52	7	107
1799	49	10	66	4	129
1800	52	16	88	6	162
In 8 years of war	341	132	589	62	1124
Peace 1802	49	14	105	12	180
War 1803	60	16	111	17	204
1804	49	11	57	10	127
1805	41	22	75	10	148
1806	43	19	85	33	180
1807	54	17	98	21	190
1808	52	9	94	17	172
1809	71	19	132	21	243
In 8 years	419	127	757	141	1444
1810	52	9	114	25	200
1811	58	15	134	17	222
1812	53	13	123	24	213
1813	47	7	117	20	191
1814	53	6	119	21	199
Peace 1815	44	10	82	26	162
1816	34	4	49	22	109
In 7 years	341	64	738	115	1298

The last period presents a good deal of fluctuation; still the annual average is fully equal to that of the preceding series.

The total length of paved streets and paved roads in England and Wales is (from a Parliamentary return in 1818) nearly 20,000 miles. The total length of all other roads nearly 96,000 miles. In France the highways are under the care of government, and are kept in repair out of the general taxes, without any tolls or turnpike dues; in Eng-

Agriculture. land they are managed by the respective counties, represented by Commissioners, and no part of the expence comes out of the public treasury. It is defrayed partly by local imposts, partly by dues levied: the local impost is discharged either by labour or by composition money; thus:

The value of labour in kind (on an average of the years ending October 1812, 1813, and 1814) was,	L. 535,423
The average amount of composition money, ...	278,506
The average amount of dues or rents levied, ...	601,954
Annual average of the expenditure on the roads of England and Wales,	L.1,415,883

being at the rate of nearly L. 12, 6s. 8d. *per* mile. In the Highlands of Scotland, where the travelling is so much less, one-third of this allowance is sufficient for the annual repair of the roads.

Canals. The Canals of England are extremely numerous; no country except Holland entering into competition with us in this respect. Among the principal are the Grand Junction, advancing from London above 100 miles into the midland counties; the Grand Trunk, extending from the Severn northward into Staffordshire, a distance of 139 miles; the Liverpool and Leeds, extending 130 miles; the Oxford 91 miles. To proceed with the enumeration would be almost endless; suffice it to observe, that the English canals are of moderate size, being from 25 to 30, 35, and 40 feet in width, and, in general, from 5 to 6 in depth; the barges navigating them are very long, frequently 70 or 80 feet on a width of 10, 12, or 14 feet; but in many cases their dimensions, at least their width, are necessarily smaller, the less frequented canals being narrower than those we have mentioned. Could the application of steam to navigation have been foreseen, the canals of England would have been made much wider; at present there would be great hazard of injury to the embankments, from vessels so propelled.

Bridges. The principal Bridges in the kingdom are the five erected across the Thames at London, three of which have been opened since 1817. Of these, two, the Southwark and Vauxhall, are of cast iron; the former of three very large arches, the latter of nine arches, each of 78 feet span. The first example of an iron bridge on a large scale, either in England or any other country, was that erected in 1796, at Waremouth in Durham, the span of which was 240 feet. In the same year was finished at Buildwas, near Colebrook, Deal, over the Severn, an iron bridge 130 feet in span. See Bridge in this *Supplement*.

IV.—*Agriculture.*

Of the state of English agriculture in former ages, we can form some idea from a reference to the acts of the legislature. In these we find, at a very early date, the traces of that policy which expects abundance and cheapness to result from discouraging the export of corn. No permission of export seems to have been granted till 1394, and then only, on the payment of certain duties: in 1436, some additional latitude was given, and export was allowed, when the quarter of wheat did not exceed a price corresponding to nearly 13s. of our present money. The reign of Elizabeth was the epoch of a great rise in the prices of corn, originating, not as was vulgarly asserted, in the "decay of tillage," but in the sudden depreciation of money, produced (as we have explained under the head of Corn Laws) partly by degradation of the coin, and partly by the influx of silver from the mines of America. The complaints of the "decay of tillage," if they express any thing more than the ordinary discontent of the ignorant part of the consumers, are to be accounted for by the gradual consolidation of small farms, and by inclosing land for pasture, with a view to the export of wool. In these days, however, government participated in the prejudices of the people; and the general purport of the acts passed under Elizabeth and her successors, was to shackle export and prevent a rise of price. It was not till the reign of Charles II. (1670) that the export of corn was exempted from a tax; and it is from 1689 that we are to date that fundamental change in our Corn Laws, which encouraged export by a bounty.

The prices of corn in England have been regularly noted only since the middle of the seventeenth century; yet this comparatively short record is of importance, as indicating very remarkable fluctuations. The price of wheat, which, in the beginning of last century, was 50s. became reduced to 40s. 30s. and eventually, in the ten years between 1740 and 1750, to so low a rate as 24s. a quarter. No wonder that the culture of corn should now receive a check, and that a large proportion of our arable land should be transferred from tillage to grazing. The effect of this conversion, and of an increasing population, raised the price of corn in the ten years from 1750 to 1760, to an average of 42s. 6d.; and, in a few years more, turned the scale from export to import; a change which, with more or less fluctuation, has continued ever since. From 1764 to 1790, the average price of wheat varied from 42s. to 50s.; our annual imports from 200,000 to 500,000 quarters of all kinds of corn. But since 1792, the average prices have been from 50 to 60, 70, 80, 90, and even 98s.:* our annual imports from half a million to two millions of quarters of corn of all kinds.

These periodical statements are useful in showing the proportion that our corn produce has at different times borne to our population. Another mode of forming an idea of the progress of agriculture is by the number of acts of parliament passed annually for inclosing common-land. The first parliamentary act that seems to have been thought necessary, or of which we have a record, was in the reign of Charles II.; the next in that of Queen Anne. From this

* See the Article Corn Laws, Vol. III. p. 352, of this *Supplement*.

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time forward, such legislative permissions were accounted indispensable preliminaries to inclosing commons. We subjoin a list of them from the proceedings of Parliament.

	Inclosure Acts.	Average Number of these Acts annually.
From 1719 to 1759, there were passed . .	249	8
From 1764 (when the price of corn rose) to 1779,	941	58
The absorption of capital in the American war affected the extension of tillage, and the average, from 1780 to 1794, was only	445	30
The high prices of 1795 and 1796 multiplied inclosures, and produced for those two years, .	146	73
From 1797 to 1803, both years inclusive, .	581	83
From 1804 to 1811, ditto,	736	92

Since 1811, the change in political circumstances has caused considerable fluctuation. We add the number of acts in each specific year.

In 1811 (high prices), . . .	134
(This is the greatest number in any year.)	
1812 (very high prices), . . .	123
1813 (peace had become probable),	117
1814 (peace), . . .	119
1815 (Prices had fallen greatly), .	82
1816 (Great agricultural distress), .	49

The average extent of each inclosure is computed at 1200 acres; the outlay about L.10 *per* acre.

The total superficial extent inclosed, in virtue of acts of Parliament during the last 100 years, may be calculated, or rather guessed, at nearly five million of acres. These acts relate only to England and Wales; for in Scotland such improvements do not require a special authority.

Size of Farms.

We have already, in the article AGRICULTURE, treated of the points of superiority in our husbandry over that of the Continent, ascribing it to various causes, and to none more than the medium size of our farms, which differ equally from the large unmanageable tracts held by Polish noblemen, and the diminutive occupancies so common among the French peasantry, particularly since the Revolution.

The size of farms in England is greatest in the best cultivated districts; that is, in the counties to the east of the metropolis,* viz. Kent, Essex, Suffolk, and Norfolk. Farms are extensive, also, in Northumberland. In these counties, the engagements of farmers are for larger sums than in East Lothian, Berwickshire, or any part of Scotland; rents being frequently from L.800 to L.1200 and L.1500 a-year. In more retired districts, particularly in Cumberland, Westmoreland, and Wales, the occupancies, whether farmed or held in property, are in general very small; and an average of all the farms of England and Wales would not much exceed L. 150 a-year.

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Leases in England are, with the exception of particular districts, granted for seven years only; when the term is longer, the case is peculiar, and applies to land that evidently requires very extensive improvement. Farms are also let occasionally from year to year. There is in such cases something like an assurance, on the part of the landlord, that the tenant shall not be removed for a certain number of years, or that otherwise the improvements shall be considered and allowed for. When a tenant holds from year to year, there is a written agreement, with specified covenants; the tenant being subjected to fines in the event of a deviation from them. † Both methods are highly injudicious; and it is in the prevalence of them, more than in the existence of tithes and poor's rates, that we are to look for the backward state of agriculture in many of our finest counties. No class of men have more liberality than the English landholders; but it would be in vain to expect a tenant to lay out much capital on the improvement of a farm of which his tenure comes to an end in seven years, or may be disturbed by the commission of a trespass, or the occurrence of a death. A tenant so situated loses the habit of reflecting on improvements, and even of carrying into effect those which he is aware would, in time, be advantageous. If he succeed in saving money, he is much more likely to place it out at interest than to employ it in his own business.

Exxpence of Cuultivation.

The expence of cultivation has increased greatly during the present age; the enhancement consequent on war and taxation not having been counteracted in agriculture, as in manufactures, by ingenious discovery, improved machinery, or any great augmentation of capital. The following table contains the averages of three distinct years, at periods considerably remote from each other.

Average Expence of Cultivating One Hundred Acres of Land, for three distinct years. ‡

	1790.			1803.			1813.		
	L.	*s.*	*d.*	*L.*	*s.*	*d.*	*L.*	*s.*	*d.*
Rent	88	6	$3\frac{1}{4}$	121	2	$7\frac{1}{4}$	161	12	$7\frac{3}{4}$
Tithe	20	14	$1\frac{3}{4}$	26	8	$0\frac{1}{4}$	38	17	$3\frac{1}{1}$
Rates	17	13	10	31	7	$7\frac{3}{4}$	38	19	$2\frac{3}{1}$
Wear and Tear	15	13	$5\frac{1}{4}$	22	11	$10\frac{1}{4}$	31	2	$10\frac{3}{4}$
Labour	85	5	$4\frac{3}{4}$	118	0	4	161	12	$11\frac{1}{4}$
Seed	46	4	$10\frac{1}{4}$	49	2	7	98	17	10
Manure	48	0	3	68	6	2	37	7	$0\frac{1}{4}$
Team	67	4	10	80	8	$0\frac{1}{4}$	134	19	$8\frac{1}{4}$
Interest	22	11	$11\frac{1}{2}$	30	3	$8\frac{3}{4}$	50	5	6
Taxes							18	1	4
Total	411	14	$11\frac{3}{4}$	547	10	$11\frac{1}{2}$	771	16	$4\frac{1}{4}$

* Arthur Young *On the Progressive Value of Money*, p. 7.

† Evidence of Surveyors in *Corn Committee Reports*, 1814.

‡ Returns made to the Board of Agriculture, and published by Arthur Young.

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The last column may be taken as a fair representation of agricultural expence at the present time. There have been reductions in some particulars, especially labour and taxes; the tax on horses employed in husbandry (17s. 6d. a-head during the war) having been materially reduced in 1816; but this is balanced by some additional expences, particularly the charge for manure, which is not fully stated in the above column. Surveyors are accustomed to calculate the produce of land with reference to the rent: highly cultivated land ought to produce three rents, that is, one-third of the gross produce should go for the rent, another for the expences, and the remainder for the farmer's profit; inferior land, requiring additional expence in cultivating, the rent is in general only a fourth, sometimes only a fifth, of the gross produce. * It was in 1813, after the discomfiture of Bonaparte in Russia, that land surveyors began to lower their estimates of rent, in the prospect of peace. †

Cattle, Sheep, &c.

A century ago, our cattle, from feeding on wastes and commons, were not one-half, sometimes even not one-third, of their present weight. To calculate the number of cattle in England is a matter of considerable difficulty. It is commonly computed to contain from 4,000,000 to 5,000,000 oxen. Horses are, of course, much less numerous, and do not appear to exceed 1,500,000, of which about 1,000,000 are used in husbandry, 200,000 are kept for pleasure, and 300,000 are colts and breeding mares. In all these departments of rural economy, an increase of number takes place as improvements are introduced, and pasturage ameliorated; but, in one of the humbler objects of a farmer's care, we mean poultry, the progress of society operates to produce a reduction. This is owing chiefly to the number of farm houses diminishing as farms increase in extent, and to the abridged supply of that waste provision which forms the chief food of poultry.

The number of sheep in England is a point of interest, both in a manufacturing and agricultural sense. We are inclined to take the average at 18,000,000 or 19,000,000 sheep, and 7,000,000 lambs. The number of long-woolled sheep is fully 4,000,000; their fleeces average 7 or 8 lbs.; of short-woolled sheep the quantity is much greater, and probably exceeds 14,000,000; but the average weight of fleece is only from 3 to $3\frac{1}{2}$ lbs. The whole quantity of wool annually shorn in England seems above 80,000,000 lbs. The merinos were introduced about the beginning of the present century, and were imported in large numbers after our alliance with Spain, in 1809. Opinions differ in regard to their utility, the carcase not having answered so well as the fleece. Considerable advantage, however, has been derived from crossing them with our own breeds, and farther experience may lead to more beneficial results.

The great pasturage counties are Leicester, Northampton, Lincoln, and Somerset. Of the counties for butter and cheese, the principal are Cheshire, Gloucestershire, and Wiltshire. Of butter, England, from the richness of her pasture, should naturally make large exports; but taxes press so much on our agricultural produce, that our Custom-house returns exhibit no shipments worth notice, except to the Brazils and to our own colonies in the West Indies and North America. In fact, in this respect, our agriculturists have stood in need of prohibitory duties on the produce of the Continent.

Import of Butter and Cheese into Britain from the Continent, chiefly from Holland. ‡

	Butter.	Cheese.
In 1812,	25,867 cwt.	87,657 cwt.
1814,	115,776	145,562
During nine months of 1815,	90,000	76,630

At that time the rate of duty on foreign butter imported was only 5s. $1\frac{3}{4}$d. *per* cwt.; on foreign cheese only 4s. $4\frac{1}{4}$d. *per* cwt.; but, in 1816, these duties were quadrupled, and the imports greatly reduced. From Ireland, the imports of butter to London only were, in 1812, 160,000 cwt.; in 1816, they were of nearly equal amount. At that time prices were low, but, since the imposition of the high duties on Continental butter, the Irish are assured of a steady demand and good price for this very important article of their produce.

A national peculiarity, of some importance in itself, and claiming our notice in connection with the nature of our climate, is the much larger consumption of butcher-meat among the lower orders of our people than in the same class on the Continent, particularly in France. This has long been the case. It was a saying of Prince Maurice of Nassau, the able successor of the first Prince of Orange, that the English soldiers newly come over were, on account of their generous food, " fit for enterprises of high mettle." §

Rate of Farming Profit.

The annual amount of profit from farming, that is, the return for the capital and personal labour of farmers throughout the kingdom, is as little susceptible of a definite calculation as any thing in the range of statistics. It can be judged of only by approximation, and by adopting the broad rule of land surveyors, who, in their estimates, assign an equal sum for farming profit as for rent; this gives nearly thirty millions for the farming profit of England and Wales; an estimate confirmed by the returns under the property-tax, as well as by the probable amount of the farming capital of England, viz. between L. 250,000,000 and L. 300,000,000 Sterling.

Total Annual Produce of England.

Connected with these calculations, is the value of the *total* annual produce of land in England. This is necessarily subject to fluctuation; the high price of a particular season leading, in the next, to an extended tillage, and *vice versâ*. Taking wheat at the medium of 80s. and other corn at

* Evidence in *Corn Committee Reports*, in 1814. † Ibid.
‡ Returns to the House of Commons, 1816.
§ Sir William Temple *On the Netherlands*, Chap. IV. p. 102.

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the prices at which importation begins to be allowed, we shall find an average produce of somewhat more than sixty millions Sterling in corn; to which, adding a similar value in pasturage, and a farther allowance for hops, fruit, and vegetables, we have a total of from 130 to 140 millions. Such seems to be the collective value of the annual produce of the land of England and Wales, and of the labour and capital bestowed on it. That this estimate is not materially wrong, appears from a reference to the government returns of rent (under the property-tax), which, in 1810, amounted to nearly thirty millions; and it is common to consider the rent from a fourth to a fifth of the gross produce.*

Comparison with Scotland and the Continent.

In Scotland the rent bears a higher proportion to the gross produce; being in general not less than one-third. (*Evidence in Corn Committee Report,* 1814.) This is owing, certainly, not to greater capital, and still less to superior soil, but to an exemption from tithe and poor's rate; also to the use of long leases. A farther difference of rent in favour of Scotland is found, on examination, to be but apparent, and is explained by the larger size of the Scotch acre. It is in tillage, not in pasturage, that the Scotch farmers lay claim to superiority. On comparing English agriculture with that of the Continent, we find that our chief superiority consists in machinery and live stock. Thrashing machines are, in a manner, unknown on the Continent, and all iron manufacture is of inferior quality. In regard to live stock, the countries that approach nearest to us are Jutland, Holstein, Holland, Flanders, and Normandy, all evidently indebted for their extensive pasturages to the vicinity of the sea; in the interior of the Continent, pasturage is, in general, very indifferent. Even in these maritime provinces, the cattle, though frequently large, are not fattened in the same gradual manner as in our grazing counties; the meat, consequently, is not of equal flavour. In horses the inferiority is more apparent to the eye, and holds both as to size and shape. Flemish horses are large, but heavy, while the Norman breed, though capable of much labour, is small in size when compared with the English. No where are horses seen of such bulk and strength as the drays in London: if they are, as is supposed, of foreign origin, they have greatly surpassed the primitive stock, since neither the Netherlands nor Holstein can now match them.

The Corn Committees of Parliament, in 1813 and 1814, collected a great deal of useful information relative to the agriculture of the Continent, and the price at which foreign corn could be imported into England. That price is not so low as may at first be imagined. In Poland, land and labour are very cheap, but the means of bringing down the grain from the interior are very limited. The great rivers are navigable only at particular seasons, and the labour of conveyance is considerable, when we take into account the bringing back the barks with men and oars against the current. It is thus profitable to ship for England only when the London market is at or above 70s.† The quantity of wheat annually exported from Poland varies from 200,000 to 500,000 quarters; that from Pomerania, and the rest of Germany bordering the Baltic, from 100,000 to 150,000. Flanders seldom makes a large export; the year 1810 affording almost the only example of the kind in the present age. In Russia, the price of wheat, though considerably lower than in England, is said to have risen since 1780 in nearly the same ratio; and in France, landed property is burdened with a direct tax (the *foncier*) of 25 *per cent.* on the rent, which, of course, enhances materially the price of produce. These facts are useful in enabling us to arrive at a definite conclusion on a topic hitherto involved in vagueness and obscurity,—the relative prices of corn in England and the Continent. To consumers on the spot, prices are, on an average, about 30 *per cent.* below our peace currency, which corresponds to a difference of 25 *per cent.* when the freight and other import charges are added to the price on the spot. In butcher-meat, the Continent, in general, is also about 30 *per cent.* below the peace prices in England. The variation of prices among the continental countries is much smaller than we generally imagine; and the variation from season to season is also much less than in England, because butcher-meat enters comparatively but little into the food of the lower classes.

We cannot close this part of our subject without a few remarks on the connection between the state of our agriculture and the extent of our financial burdens. Those who compare the heavy pressure of our taxes with the lighter burdens of our continental neighbours, have, in general, the satisfaction of finding some counterpoise in the superior dexterity of our people, and the productiveness of our capital. This holds true, in regard to our navigators, our merchants, and our manufacturers; and it holds in agriculture in regard to grazing; because in grazing little personal labour is requisite, while capital and active habits of business are of the most beneficial operation. But, in the department of tillage, much remains to be done ere England can claim any great superiority. Farms are yet too small in more than two-thirds of England; and leases generally too short. The course of husbandry is frequently injudicious, the ploughs on a bad construction, and there exists a gross misapplication of animal strength. However light the soil, and however strong the horses, it is still customary to put three four, and frequently five, in a plough, throughout almost all our west and south-west counties. These are the main causes of the comparative unproductiveness of our finest counties, and of our being obliged to pay so heavy a premium in the shape of corn laws to support our agriculture. Without the corn laws, our lower classes would be supported on nearly the same terms as their continental neighbours;

* See the preceding Table of the number of acres under cultivation in England; also the article CORN LAWS, p. 364.

† Evidence of Mr Jolly, *Corn Committee*, 1814.

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and there would be no occasion, with all our taxes, to dread the competition of foreigners in almost any branch of industry; but, if the manufacturers of England are obliged to pay for their support 30 *per cent.* more than those of France and Germany, while their wages are very little higher, what other prospect have we than that of increasing emigration, and the augmentation of the poor rates?

The quantity of land still lying uncultivated in the shape of wastes and commons, is a frequent topic of animadversion; persons unacquainted with agricultural calculation calling loudly for their being brought into culture, while the landed interest object to passing a general inclosure act, or, in other words, to giving unlimited scope to speculative cultivation. We by no means participate in their apprehensions; but we would abstain from giving any artificial stimulus to this, more than to any other branch of industry. Let the progress of inclosure be regulated by the gradual increase of our population, and the discovery of better methods of turning such land to account. No benefit can be derived from applying to this purpose any more capital than goes into it voluntarily; and every experienced farmer is aware, that the best prospect of profit lies not in reclaiming new soils, but in bestowing farther labour and expence on the land already under culture.

V.—*Mines—Quarries—Iron, Copper, Tin, and Salt Works.*

In regard to minerals, England does not yield to any country in Europe in natural abundance, and takes the lead of all in the extent to which these rude treasures have been converted to purposes of utility. Our great superiority lies in our coal-mines, which are not only more productive, but much more advantageously situated than those of the Continent. To the mines along the coast, a ready conveyance is afforded by our insular position, and to those in the interior by our inland navigation. The consumption of coal in England, for domestic use, has been computed, or rather guessed, at 15,000,000 of tons annually. Large as this quantity is, and larger as it must be, when we add to it the vast consumption of manufactories, such as iron-works, salt-works, glass-houses, &c. there is no reason to apprehend the exhaustion of this precious mineral; the depth of the coal beds being very great, and the extent of ground containing them amounting to many hundred thousand acres. The principal tracts for coal lie in Northumberland, Durham, Derbyshire, Staffordshire, and Glamorganshire. The ports for shipping it in large quantities are Newcastle, Sunderland, Swansea, and Whitehaven. The motive of the tax on coal exported to foreign countries is thus neither an apprehension of eventual scarcity, nor even a calculation of revenue, so much as a dread of giving our continental neighbours the means of rivalling our manufactures. Coal is not wanting in France and Germany, but the mines are at a distance from water-carriage, and as yet very imperfectly wrought, while for domestic fuel the inhabitants give a preference to wood.

Duty on Coal shipped to foreign parts, reckoned by the Newcastle chaldron, which is nearly double the Winchester.

To the United States, in British shipping,	L. 0	17	0
——— in foreign shipping,	1	10	3

To the Continent of Europe, or any foreign country, except the United States.

In British shipping,	L. 1	2	0
In foreign shipping,	1	15	4

Home Duties on Coal since the Peace in 1814, per Winchester chaldron.

Carried coastways to London,	L. 0	9	4
To any port in England, except London,	0	6	0

Amount of Duty paid on Coal in the following years:

	1815.	1816.	1817.
	L.	L.	L.
Home-duty in the port of London,	535,157	570,066	538,342
Total home-duty on coal carried coastways in England and Wales, including London,	894,497	930,496	885,973
Duty on coal exported to foreign parts,	77,750	63,182	54,326

Quantity of Coals shipped coastways in England in the year 1817.

	Winchester chaldrons.
Newcastle,	1,189,319 89,576
Sunderland,	688,901
Swansea,	126,150
New Port and Cardiff,	38,113
Llanelly in Caermarthen,	30,206
Liverpool,	18,697
Pembroke,	17,613
Whitehaven,	17,062
Hull,	12,921
From all other parts,	17,093
	2,245,651

Export of Coal in 1817 to Ireland and foreign parts.

	Winchester chaldrons.
Whitehaven (chiefly to Ireland),	184,092
Liverpool, do.	53,000
Swansea, do.	28,664
Llanelly (all to Ireland), (In Caermarthenshire.)	18,459
Chester (chiefly to Ireland),	17,000
Preston in Lancashire,	5,379
Newcastle to foreign parts,	96,000
Sunderland do.	22,000
London,	8,000
Other parts in England,	98,406
Ports of Scotland to Ireland,	122,000
——— to other parts,	12,000
	665,000 *

* All these statements are taken from *Returns to the House of Commons in May and June* 1818.

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To Scotland, a considerable quantity of English coal (about 40,000 chaldrons) is shipped annually. In Wales, the coals carried coastways are chiefly from Swansea to Beaumaris, and vary from 20,000 to 30,000 chaldrons: the culm carried coastways in Wales goes chiefly to Pembroke, Cardigan, and Beaumaris, and is computed about 18,000 chaldrons.

Of inland coal, the consumption in London is very inconsiderable, the duty not exceeding L. 1600 a-year. Recent discoveries in regard to the application of steam, both for cooking and for warming apartments, appear to promise a considerable reduction in the consumption of coal. Much apprehension was excited in the coal counties, by a proposition brought forward in the present year (1819), for an equalization of the duty on coal, on the plan of relieving London and the maritime counties, by finding an equivalent to government in a reduced tax imposed on all coal, or, to use the technical phrase, on "coal at the pit's mouth." This equivalent might have been found by a very reduced rate of tax, since the whole of the coal that at present pays duty appears to be below a fourth, perhaps below a fifth, of the total consumption. But this apparently small tax was represented as replete with ruin to many of our manufactures, whose situation had been determined by the cheapness of coal, and whose preservation depended on a continuance of this advantage. The petitions soon became so numerous and urgent, that Ministers hastened to announce that the idea was wholly relinquished on their part, and the question, when brought forward by an individual member, was lost by a great majority.

Quarries.

In quarries, whether of stone or slate, England is not rich, particularly the eastern half of the kingdom: hence the almost universal use of brick in ordinary buildings. It is not till the traveller reaches Durham, that he finds stone commonly used. In the northern counties, quarries occur frequently; in the south, those of Portland and Bath are the most considerable. Still the annual profits of the whole are inconsiderable, when contrasted with the product of our mines, as appears from the following return:

Profits in 1810 *from the Quarries, Mines, and Iron Works in the counties where they are principally situated; extracted from the Parliamentary Papers on the Property-Tax:*

	Quarries.	Mines, as well of Coal as of Iron, Copper, Tin, and Lead.		Iron-Works.
	L.		L.	L.
Cheshire, .	877	(coal and iron)	9,568	8,354
Cornwall, .	2,147	(tin and copper) -	106,028	
Cumberland,	952	(coal)	32,466	656
Derbyshire, .	1,959	(coal and iron)	18,678	34,613
Devonshire,	3,907	(tin, copper, and iron)	10,830	13,043
Durham, .	1,668	(chiefly coal)	51,071	12,259
Yorkshire, .	3,800	(chiefly coal)	34,506	7,859
Lancaster, .	3,248	(coal and iron)	30,813	18,726
Northumberland,	3,796	(chiefly coal)	45,013	17,420
Shropshire, .	1,706	(coal and iron)	21,058	6,430
Staffordshire,	327	(coal and iron)	21,366	8,393
Warwickshire,		(iron)	250	16,715
Flintshire, .		(coal)	14,019	
Glamorganshire,		(coal and iron)	28,057	29,660
Monmouthshire,		(coal and iron)	11,980	2,362
Other Counties,	4,573		47,788	46,182
Total,	L. 29,160		L. 483,491	222,672

Mines, Quarries, &c.

Iron Mines and Works

No branch of our industry has increased more rapidly in the present age than our iron-works. A century ago, it was computed that we required an annual import of 20,000 tons of foreign iron; an import that for many years seems to have been on the increase, so as to carry the quantity required, after the middle of last century, to 30,000, 40,000, and even to 50,000 tons. This supply was brought to us from Sweden and Russia, and though burdened with duty, it was, in quantity, more than double our native produce. Fortunately, after the year 1780, discoveries were made which increased greatly our supply at home. Bar iron had been manufactured in England, as on the Continent, with charcoal fuel only, coal being deemed inapplicable to that purpose. Under that impression, the rapid consumption of the wood in the neighbourhood of our different iron-works, had necessitated a removal, at a great expence, of materials from one spot to another, and was on the point of causing an alarming decay in the business, when our iron-masters, after long perseverance, succeeded in applying coal to their manufacture. They had to contend with various prejudices, particularly the supposed inferiority of iron so made; but, in the course of years, the manufacture acquired such an extent that there were, in 1805, 220 established blast-furnaces, making 250,000 tons of pig-iron. No sooner had the trade acquired this extension, than government fixed on it as a fit object of taxation, and proposed a duty on iron of 2s. *per* ton; a proposition which experienced the most decided resistance from the body of iron-masters. They urged that, to put iron-works under the regulation of the excise, would interfere materially with the manufacture; that there would be great difficulty in apportioning the drawback on the hardware articles exported; and that the expected produce of the tax would be most decidedly lessened by the additional cost of the cannon, muskets, nails, and iron-work of various kinds furnished to government. Besides, a tax on iron must be charged on articles of the greatest utility; on the implements of agriculture, manufactures, and mines; on the iron materials used in our buildings and machinery as a substitute for timber; on our rail-roads, and other undertakings of great national importance. These arguments prevailed; the Ministry of 1806 desisted, and no subsequent attempt has been made to impose a duty on iron. (*Papers printed by the Iron-masters, in* 1806.)

The principal iron mines are in Derbyshire and Glamorganshire; but there are extensive mines in other counties specified in the prefixed table. The return of peace, by suspending entirely the demand of government, caused a long and general inactivity in this important manufacture: many of our iron-works were suspended, and the workmen with their families reduced in 1816 and 1817 to great distress. Temporary relief was afforded them by private subscriptions, and by the application of the poor's rate; but it was not until the revival of business in the latter part of 1818, that the workmen were restored to employment, or enabled to earn even a scanty livelihood. Now that the works throughout the kingdom are in activity, the computation is, that 300,000 tons of pig-iron are produced in the fur-

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naces of England, two-thirds of which are made into malleable iron, the other third into castings. The capital invested in these works is reckoned at L. 5,000,000 Sterling; the population employed by them at 200,000; the whole, exclusive of the capital and population employed in the manufacture of hardware, of which we shall treat in the section on MANUFACTURES.

Copper.

Copper-mines have long been known in England, but they were wrought with very little skill or effect until towards the year 1700. Even at that time the annual produce, after smelting the metal from the ore, was only a few hundred tons of copper; and it hardly exceeded 1000 tons annually down to the middle of last century. From that time forward the increase became considerable, as well in Cornwall as in Devon, North Wales, and Derbyshire; in all of which copper mines were discovered and wrought. In North Wales there were two mines (Parys and Mona), which, for some time after the year 1780, yielded annually a large quantity of ore, but they are no longer productive: the mines of Devon and Derbyshire continue to be wrought, but the great product is from Cornwall, the mines of which yield 80,000 tons of ore annually: the metal obtained varying from 5 to 15 in the 100 parts, may be stated at 8000 tons of copper. It is the Welsh collieries that afford to Cornwall, as to Devonshire, the great means of smelting; and as the ore is less heavy than the coal required for this operation (one ton of ore requiring from two to two and a half tons of coal), the practice is to convey the ore in vast quantities to Wales, particularly to Swansea. The total quantity of coal consumed for this purpose at Swansea is nearly 200,000 tons a year; exclusive of a farther consumption of coal at the copper mines of Cornwall, in working the ponderous steam-engines used in throwing out the water from the pits. In this, as in other minerals, France is greatly behind England. She has various copper mines, but her coal mines, at least hitherto wrought, are at too great a distance to make such undertakings profitable; she consequently requires an annual import from England. For the destination of our exported copper, we refer to the following table:

British Copper exported in 1817, wrought and unwrought.

	Cwt.
From London,	85,029
—— Liverpool,	32,989
—— Bristol,	6,150
—— Swansea,	5,740
—— Other parts,	3,237
	133,145

To the following Countries.

	Cwt.
East Indies,	52,595
United States,	22,733
France,	14,550
West Indies,	11,180
Brazil,	8,382
Holland,	7,798
Other parts,	15,907
	133,145

The price of copper in 1746, and the succeeding years, was generally about 1s. 3d. *per* lb.; in 1765, it fell to 1s. 1d., in 1778 to 10d.; since 1781 it has not been under 11d. In 1805, it reached the unexampled price of 1s. 11d. *per* lb.; and large importations took place during 1806, 1807, 1808, 1809, and 1810; but the average price of the last 60 years may be called 1s. 2d. In using copper for coin, it has been proposed to take 16d. *per* lb. as the rate of value, which would leave a profit to government on the mint operation, without affording a temptation to individuals to melt the pieces. (Grenfell *on Copper Coinage*, 1814.)

Tin.

Cornwall is also the great seat of the tin-mines of England. A century ago the average produce of our tin mines hardly exceeded 1500 tons.

A century ago the average produce of our tin mines hardly exceeded	1500 tons.
From 1720 to 1740, the average produce was	2100
From 1740 to 1760,	2570
From 1760 to 1780,	2740
From 1780 to 1800,	3100

The produce of the mines does not materially differ from the last of these averages. From abroad we receive tin from one quarter only, viz. the East Indies, in particular from the Island of Banca. Of this we imported, in 1815 and 1816, nearly 600 tons, the chief part of which was re-exported to the Continent of Europe. Of our own tin, about the half is used at home, and the other half finds its way to the following countries:

Return to Parliament of British Tin Exported:

	In 1815. Cwt.	In 1816. Cwt.
To Russia,	5,556	6,139
Germany, including Prussia,	670	3,482
Holland,	600	1,562
France,	1,002	2,809
Spain,	220	1,396
Italy,	1,118	3,412
Malta,	232	1,088
Turkey,	3,708	4,252
East Indies, and Asia generally,	9,447	7,733
All other parts,	2,338	3,263
	24,891	35,136

Lead.

The lead mines of England are principally in Cumberland, Northumberland, and Derbyshire; the whole calculated to produce from 12,000 to 15,000 tons annually. Black lead is found in abundance in Cumberland, in the romantic district of Borrodale; but the mine is opened only periodically, that the market may not be overstocked.

Salt.

Salt is already a very important product in England, and is likely to become much more so from the measures urged of late years on the Legislature, part of which have been adopted, while a farther part seem only to wait a season of less financial pressure. (*Report of Committee on the Salt Duties*, June 1818.) Salt is obtained in several ways; partly from brine springs, partly from the rock, partly from sea

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water. In the last manner it is manufactured in various salt pans along the coast, viz. in Hampshire, Kent, and Essex; also in the northern counties of Durham and Northumberland, where the abundance of coal cheapens materially the expence of the process. But the great supply is from the rock salt and brine springs of Cheshire, situated in the southern part of the county, near Northwich. From these springs it is obtained (see the article CHESHIRE) at the rate of one gallon of solid salt from four gallons of liquid, while common sea water does not yield above one in twenty-eight. The price of rock-salt at the rocks is only 12s. *per* ton; it is there mixed with the brine from the saline springs, and refined in large iron pans, after which it is called white salt, and is sold, the inferior at 23s. the best from 35s. to 40s. the ton. On salt for home consumption there has been, since 1805, the enormous duty of 15s. *per* bushel, nearly fifteen times the prime cost. The sale price was thus raised to L.30 the ton. This duty has rendered to government, since 1805, no less than L.1,400,000 nett; it is, besides, of easy collection, from the mines and manufactories of salt being confined to particular districts, and smuggling readily prevented.

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This concentration will, it is hoped, be the means of facilitating materially the expected changes in the law, since it will render practicable the use of rock salt duty free to certain manufactures (as sal-ammoniac, magnesia, and Glauber's salt) without any great risk of fraud on the revenue. An act of great importance was lately passed (27th June 1817), permitting the free use of rock salt, not only in curing fish, but in making mineral alkali, an ingredient of great use as a substitute for barilla, in the manufacture of soap. This alkali is subjected to a duty, which, it is believed, may soon be raised to 10s. *per* cwt., producing about L.400,000 to the revenue. Were the whole salt duty taken off, the mines and springs of Cheshire might produce annually 24,000,000 bushels of salt, each bushel of 56 lbs.; but the actual quantity extracted, as appears by evidence before a Committee of the House of Commons, in May 1817, is only about 10,000,000 bushels.

	Year 1813.	1814.	1815.	1816.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
Northwich salt exported (this is duty free),	7,754,000	8,677,000	11,595,000	8,392,000
Northwich salt delivered for the fisheries, also duty free, . .	984,000	1,106,000	1,087,000	702,000
Northwich salt which paid duty, .	937,000	897,000	933,000	893,000

The capital vested in the works is about L.700,000: and the persons employed, including women and children, about 2400.

Our agriculture has already felt the good effects of the recent relaxation of the salt regulations. The high duty of 1805 had necessitated the absolute loss of a quantity of refuse, thrown out from the salt-pans, and eagerly bought up in former years by farriers. This precious manure is now restored, and affords the means of giving fertility to 100,000 acres annually. On salt used for feeding cattle, this duty is reduced to 5s. a bushel. For bleaching or refining, salt is delivered duty free; in the latter the quantity used considerably exceeds 1,000,000 bushels a-year. (*Return to House of Commons*, 2d April 1818.)

VI.—*Fisheries.*

A season of peace is always favourable to the extension of our fisheries; and, if we may judge from the progress lately made, this branch of our national industry is likely to be carried much farther than at any former period of our history. Of this we shall treat more fully under the article FISHERY. At present our space allows no more than a brief notice of the principal branches of our fisheries.

Mackerel.

The mackerel fishery is strictly English, and is carried on with great vigour on the coasts of Kent and Sussex, in May, June, and July. Large as the supply is, it would still admit of augmentation; and herrings, also, might be caught in vast quantities on the coast of Kent, in October and November. The *desideratum* with the fishermen, now that peace has reduced their expence, is not so much a high price as a certain market; and the most effectual way to procure that is, to quicken, by every possible means, the conveyance to London. The navigation of the Thames not being at all times certain or expeditious, it was proposed some time ago (in 1812) to improve, or rather to re-make, the road to London from the small harbour called Holyhaven, situated on the Essex side of the river, about 30 miles from the metropolis. The late discoveries in the mode of applying steam to navigation, may perhaps render this unnecessary, but it cannot supersede another and more important plan, that of accelerating, by improvements in the roads, the conveyance of fish by land carriage from Brighton, and other parts of the Sussex coast, to London. An association of gentlemen, under the name of the *Downs Society of Fishermen's Friends*, was formed in the end of 1815; they have since made several interesting reports, and give reason to hope that various improvements will be effected.

Pilchards.

The pilchard fishery takes place chiefly on the coast of Devonshire and Cornwall, and, though subject to great fluctuations, as well from the seasons as from our political situation relatively to the Con-

Fisheries. tinent, forms, on the whole, an important branch; employing a number of seamen both in catching the fish and in carrying it to foreign markets. Its season is generally from June to September.

Herring. The herring, the most important of all our fisheries, is happily now in a state of rapid extension. It formed, during the seventeenth century, the great employment of the Dutch seamen, and was contemplated by their neighbours with very jealous eyes. Accordingly, in the reign of Charles II., particularly after the rupture with Holland in 1672, several acts were passed for the encouragement of our fishermen, and in a spirit of hostility to the Dutch. The subsequent accession of William to our throne, and the long friendship between the two countries, relaxed the exertions of government; and it was not till after the peace of 1748, that a large bounty was given on the tonnage of the busses, or masted vessels, so employed. Still our fishermen proved unable to compete with the experience and patient perseverance of the Dutch, and it was found necessary to raise the bounty from 30s. to 50s. *per* ton. This had the desired effect, and the number of busses increased; but the additional 20s. being withdrawn in 1771, the fishery again declined. The American war, and, subsequently, the wars of the French revolution, proved extremely adverse to its extension: at last, in 1808, an act was passed, carrying the bounty to L. 3 a ton on the busses, with a farther grant of 2s. *per* barrel on all herrings caught whether in busses or boats. This important act was farther confirmed in 1815, and the bounty *per* barrel raised to 4s. with the essential qualification that the herrings should be gutted before curing. A farther and still more important law (27th June 1817) declares, that not only common salt but rock salt, which is much cheaper, may be used duty free for our fisheries.

These acts form the grand charter of the British fisheries. The bounty, which was formerly reckoned by the tonnage of the shipping employed, is now awarded on the quantity caught, the barrels being branded by customhouse officers. The mode of curing adopted by the Dutch has been communicated to our fishermen, and bounty refused in all cases in which either the herrings or barrels were in improper condition. The success has been correspondent: successive reports made by the *Commissioners of the Herring Fishery*, in 1816, 1817, 1818, and 1819, concur in exhibiting a progressive increase in the quantity gutted before curing, and, of course, entitled to the higher bounty. The increase of our fishing-craft, however, has been only in the number of boats. In the busses, or masted vessels, there is no augmentation, the bounty, even on its present footing (L. 3 *per* ton), being insufficient to counterpoise the superior economy of the boats. (Fraser *on the Fisheries.*)

Whale Fishery. Greenland was first discovered by the English, but in this, as in other branches of navigation, we long allowed the Dutch to take a lead. It was not till after 1750 that, government having granted a bounty of 40s. a ton on every vessel employed in the whale fishery, a considerable increase took place in this branch.

In 1750, the vessels employed were only 19; in 1756, they had increased to 67. The war soon caused a decrease of one-half; but, at the return of peace in 1763, this fishery revived, and in 1770, the vessels employed amounted to 50; in 1773, to 55; in 1775, to 96. The American war again caused a decrease, and in 1782, the vessels so employed were only 38. In 1784, they increased to 89, and in 1785, to 140; after this they exceeded 200 annually till 1793; but the long continuance of the late wars reduced them below the half; and the advantages of peace have been counteracted by causes which have as yet prevented the English vessels from regaining the number employed previous to 1793.

Newfoundland. The Newfoundland fishery has been considerable for fully a century past; as a nursery for seamen, it is accounted of such consequence as to have formed the object of a specific article in most of our treaties of peace. The fish caught, particularly in time of peace, is sent less to Britain than to the Catholic countries in the south of Europe; a market subject to all the interruptions attendant on a change of political relations. The number of vessels employed in this fishery at different times was as follows:

In 1731,	70
1764,	140
1774,	254
The American war caused a diminution, but in 1784 the number was	236
1785,	292
At this rate the fishery continued until the war of 1793, after which, particularly after our rupture with Spain in 1797, it fell off greatly; the fishing vessels in 1798 being only	140

The continuance of war, and the aggrandizement of the French in Italy, occasioned additional depression, so that, in 1810, the number of our vessels employed at Newfoundland did not exceed 92. The peace seemed to promise a revival of this important nursery of seamen, and, in the year 1816, the number of vessels that arrived in Newfoundland was 795, manned by 6000 seamen (*Report of Committee* in June 1817, p. 7); but the trade, both then and in 1817 and 1818, proved unprofitable, in consequence of indifferent seasons, of the high duty imposed on fish imported in British vessels into Naples, and of the competition of the French fishermen, who are supported by a high bounty from their government. It will thus require a considerable time to reinstate this branch of our fisheries. A treaty with the United States, concluded in the end of 1818, determines the limits within which the shipping of each nation have the power of fishing.

It is matter of surprise to foreigners that a maritime nation should not have more effectually cultivated this great means of facilitating the support of our population. The ample supply that might have been afforded by the Nymph Bank on the south-east coast of Ireland has been avowedly neglected; and it is but very lately (October 1818) that we made the discovery of a Bank of almost equal productiveness in the vicinity of Orkney. Fish is little known to

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the mass of the people in our inland counties. While the value of the butcher-meat annually consumed in England exceeds L. 30,000,000 Sterling, the value of our fish caught on our coasts and rivers hardly exceeds L. 2,000,000. Yet its price, with the economy and improved arrangements attendant on a state of peace, would not exceed 20s. a cwt., while other animal food costs fully three times that sum. It might easily be conveyed in a corned state by light waggons through the interior of the country. The *London Association for the Relief of the Poor* made, in 1812, some most encouraging experiments in this respect; having forwarded corned cod, in quantities of one or two tons, to various manufacturing towns. This cod, on being steeped 48 hours in cold water, was found to eat with potatoes almost like fresh fish. And all this was done on an extensive scale at the almost nameless sacrifice of L. 55. A spirited imitation of this example would greatly increase our exports of fish to Spain, Portugal, and the Mediterranean; while at home it would afford the readiest means of supplying a nutritious food to the lower orders; a considerable proportion of whom must, from the nature of our poor-laws, perhaps from unavoidable causes, continue for a length of time a burden on the community. To accomplish this effectually, the duty on salt ought to be entirely taken off. Fishermen living in hamlets or in detached cottages along the sea-side, can never conform to the rules of the excise, and will never, without their complete removal, be able to fish at any day and hour that may suit their other avocations. Every great fish-market should have beside it a salting-house for curing the fish remaining unsold at a prescribed hour; these might afterwards be sent into the country, or put apart for a winter store. *

VII.—*Manufactures.*

Woollen Manufactory.

In this great department of our productive industry, we begin with woollens, which, although no longer the largest of our manufactures in point of export, nor even in the value annually made, is entitled to the first place from the priority of its establishment, as well as from the substantial basis on which it rests. England, from the extent of her pastures, abounded in wool from a very remote age, and the inhabitants were, doubtless, capable of manufacturing it into rude clothing; each weaver working in his separate cottage, and with very little aid from machinery. In the twelfth and thirteenth centuries, we appear to have had only the most humble fabrics, and to have imported all cloth of finer texture; sending abroad our wool in quantities to Flanders, a country whose inhabitants were at that period much farther advanced than the rest of Europe, with the exception of Italy. It was in the middle of the fourteenth century that a better system was introduced. Flemish manufacturers were invited over to England, and improved greatly the quality of our home made woollens. The seats of this branch of industry appear at that time to have been Kent and Essex; afterwards Gloucestershire, and subsequently the West Riding of Yorkshire. It occupied at first the southern and more improved districts, and spread afterwards to the northward, on account of the cheapness of labour, the abundance of coal, and the convenience of waterfalls for the machinery. The general character of the woollen manufacture of England has been that of slow progress, but of little fluctuation; the latter evidently a consequence of its depending much more on home consumption than on export. It was extended, not like cotton and hardware, by means of discovery and invention, but by the progressive increase of our population; having been so considerable in the end of the seventeenth century, that the total value of woollens manufactured was computed at eight millions sterling, of which five were for home consumption, and three for export. In the long period from 1700 to 1780, the exports experienced a regular, but not rapid rise; amounting in the latter years (after distinguishing between the real and the customhouse value) to an average of six millions sterling, while our home consumption increased in proportion to our augmenting numbers. After the peace of 1783, woollens partook of the benefit of several of the mechanical discoveries and inventions of the cotton manufacture, and continued to extend, notwithstanding the competition of other countries, as appears by the following table:

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Export of Woollen Manufactures, not official, but real value. †

1790, (peace)	L. 7,300,000
1791,	7,700,000
1792,	7,700,000
1793, (war)	5,200,000
1794,	6,600,000
1795,	7,600,000
1796,	9,000,000
1797,	7,400,000
1798,	9,700,000
1799,	10,200,000

Of these extensive exports, the largest proportion went to the United States; our shipments thither, in 1770, exceeded L. 2,000,000, and, increasing regularly with the capital and population of America, amounted, in 1799, to L. 4,000,000. Holland was also a good customer; and to Portugal and Spain our exports were not inconsiderable. From 1800 to 1807, the woollen manufacture was, on the whole, thriving, and our exports were large and steady; but after 1808, the Orders in Council, Bonaparte's pro-

* Sir T. Bernard *On the Employment of the Labouring Classes.*

† *Official* value is distinct from *real* value, being a computation founded on a series of rules for estimating merchandise by the package, prescribed so long ago as the year 1696. The increase in the value of commodities since then, though very different in different articles, has been fully 50 *per cent.* on the whole, which it is necessary to add, to arrive at the *real* value.

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hibitory decrees, and our unfortunate disputes with America, caused a great fluctuation and diminution in our exports.

Export of Woollens from Britain.

1808,	L. 7,280,370
1809,	8,124,226
1810,	8,659,821
1811,	6,564,817
1812,	7,627,486

The political agitations of these years were productive of great distress among the woollen manufacturers, particularly in 1811 and 1812, as was but too amply shown by the mass of evidence collected for the repeal of the Orders in Council in the latter year. This distress would have been still greater, had not the large demands of government for army clothing in some degree supplied the blank.

Export of our Woollens in Peace.

Years.	Value.
1814,	L. 7,567,507
1815,	10,198,334
1816,	8,404,481

We select 1815, a year of large export, for the purpose of showing the proportion in which our woollens are sent to different countries.

YEAR 1815.

Countries.	Value. (Real not Official.)
Germany, including Prussia,	L.539,745
Netherlands,	383,446
Portugal,	727,805
Spain,	231,610
Gibraltar,	137,605
Italy,	124,556
Malta,	153,327
Ireland, and Isle of Man,	822,230
East Indies,	1,062,926
America, viz. United States,	4,378,198
Our North American Colonies,	599,686
West Indies,	357,896
Colonies of other powers,	427,431
To all other parts,	251,873
	L.10,198,334

The year 1799 was one of unexampled demand and high price. An inquiry, instituted the year after by Parliament, into the state of the woollen manufacture, afforded a variety of useful *data* relative to the extent of capital and number of persons employed. The result, as far as the name of result can be given to inferences founded on a partial knowledge of facts, was, that the

Total annual value of woollens manufactured in England was	L.20,000,000
And the value of the raw material,	6,000,000

leaving a much larger proportion for wages than in the case of our cotton manufacture;—a circumstance which would be of very serious import to a country so much more loaded with taxation than its neighbours, were it not in a considerable degree counterbalanced by the raw material being of home growth.

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It was computed in 1800, that of the whole woollens made in England, more than a third was manufactured in the West Riding of Yorkshire; a proportion which, from the advantages of this quarter over others, is now, we imagine, not far below one-half. Wiltshire, Gloucestershire, and Somersetshire, are the other seats of this manufacture. For shipping our woollens, London was long the only considerable port. About the year 1700, the usual exports were to the value of a million from the outports, and of two millions from London, where the business was managed by the Blackwell hall factors; but since inland navigation has become extensive, the Yorkshire woollens, even when bought up by London merchants, are in general exported from Liverpool.

Extensive as are our sheep pastures, our manufacturers find it necessary to make an annual importation of foreign wool. This takes place from different parts of Europe.

Countries from which Wool was Imported into England in 1815.

	Lbs.
Germany,	3,137,000
France,	757,000
Portugal,	1,146,000
Spain,	6,929,000
Ireland, and Isle of Man,	1,355,000
Other parts,	1,667,000
Making a total of	14,991,000

(*Customhouse Returns to Parliament*, 1816.)

These importations being duty free, and operating materially to keep down the price of English wool, the venders of the latter, or, as they are termed, the wool-growers, have of late years been very urgent with Government to impose a duty on foreign wool, not on the Spanish, which they admit to be necessary as a mixture with our own, but on those species of foreign wool which come more immediately into competition with their own growth. They took occasion, under the auspices of Lord Sheffield, to bring their claim before Parliament during the agricultural distress in 1816; but the committee appointed to consider of it made no difficulty in declaring, that no part of that distress arose from an inadequate price of wool; and the evident impolicy of burdening a raw commodity which employs the labour of so many thousand individuals, prevented ministers from listening to such applications, until the financial difficulties of the present year led at last (Mr Vansittart's *Speech*, 7th June 1819) to the proposition of a small duty calculated to produce L. 100,000. The importations are a full tenth of the total consumption, having in 1818, as in 1814, exceeded 15,000,000 lbs. The wool-growers complain of the great pressure of taxation, but the price has also

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risen considerably since the beginning of the wars which aggravated our financial burdens.

In the twelve years that elapsed from 1789 to 1800, there took place a rise of 20 *per cent.*: of the subsequent prices, an idea may be formed from the following table:

Prices of Fleece Wool in the years between 1801 *and* 1815. (*Evidence before the Committee on Seeds of Wool*, in 1816.)

Years.	Best Sussex Downs, *per lb.*	
1801	21*d.* to	22*d.*
1802	20	22
1803	19	21
1804	22	24
1805	28	30
1806	22	24
1807	22	24
1808	23	24
1809	32	36
1810	28	30
1811	20	21
1812	23	24
1813	23	24
1814	26	28
1815	21	24

The quantity of wool grown, on an average, in England is 144,000,000 lbs.* two-thirds of which consist of short clothing wool, and one-third of a much more valuable kind, called long combing wool: the latter has, it seems, never been produced on the Continent of a quality equal to ours, except in some small districts in Flanders. The ordinary length of the staple of foreign wool is about two inches; that of our long combing from five to seven inches. Without the latter, the continental manufacturers cannot equal us in the stuff goods and others made from fine worsted; and hence the importance, say our woollen manufacturers, of keeping the law as it stands; that is, not only of receiving foreign wool, but of preventing the export of our long wool.

The progressive augmentation in the import of Spanish wool is of importance, as indicating the increased fineness of our cloth.

	lbs.
In the early part of last century, this import did not exceed	1,000,000
It increased very slowly, for, on an average of five years, ending with 1776, it was not quite	1,600,000
But in the five years ending 1787, it was nearly	2,000,000
In the five years from 1787 to 1792, it exceeded	3,000,000
From 1792 to 1800, the average was nearly	4,000,000
Since 1800, though fluctuating from political causes, it has considerably increased, and now averages nearly	6,000,000

Manufactures. Cotton Manufacture.

Our cotton manufacture is entitled to the greatest attention on different accounts. Of all our manufactures, it affords the largest export, and exhibits the most rapid improvements in machinery. Its introduction, though not remote, is less recent than is commonly supposed. It appears to have taken place about two centuries ago, when it was established at Manchester; but it was long conducted on a very limited scale. The raw material, imported at first only from the Levant, in particular from Smyrna, began, after 1660, to be supplied by our West India colonies. The quantity imported amounted, about the year 1700, to 3500 bales; but, increasing with the extended cultivation of our colonies, it averaged, about the year 1720, something more than 7000 bales. From the colonial conquests of the war of 1756, our import of cotton received a farther augmentation; but the manufacture increased very slowly, a great part of our cotton being re-exported to Holland, for the supply of Dutch and German weavers. It was not till after the peace of 1763, and the invention, first of a carding machine, and next of the spinning jenny, that this manufacture became considerably extended. In 1775, the average import of cotton approached to 18,000 bales. A variety of improvements, explained in our article on Cotton Manufacture (pp. 396, 397), now took place, and increased the average import of the raw material, in 1781, to 25,000 bales. Fine calicoes and muslins were now introduced; the workmen were withdrawn from their detached dwellings, and collected into large factories; and the price of the finished article experienced a reduction, notwithstanding a rise in the raw material, and the wages of labour. The period that followed the peace of 1783 is perhaps unexampled in the history of human industry, for the rapidity of discovery, the reduction of price, and the extension of sale that took place in regard to cotton goods. The unexpected commencement of hostilities in 1793 gave this branch of our industry a severe shock, but the improvements in machinery continuing, the cotton manufactures soon recovered, and increased beyond expectation; requiring a progressive and large augmentation of the import of the raw material, as appears by the following table:

	Bales or Packages of 275 lbs. each.
Average import of cotton in five years, ending with 1796,	98,000
Average of the next five years, ending with 1801,	153,000
Average of the next five years, ending with 1806,	214,000
Particular Years.	
1807,	283,000
1808, (Orders in Council),	168,000
1809, (Orders in Council relaxed),	440,000
1810, (ditto ditto),	561,000

* Maitland *On Wool*, a pamphlet published in 1818.

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Particular Years.		Bales or Packages of 275 lbs. each.
1811,	(Distress of trade; suspended intercourse with the United States),	326,000
1812,	(War with the United States),	261,000
1813,	. .	249,000
1814,	(Peace),	288,000
1815,	. . . .	369,000
1816,	. . . .	369,000
1817,	. . . .	479,000

Of these large imports, a very small part came from the Levant, our original source of supply; our West India colonies contributed more; the East Indies sent at times large, at other times insignificant shipments; Brazil was more regular; but the grand supply was from the United States, where, in the southern provinces of Carolina and Georgia, the culture of cotton has been rapidly extended since 1790. Of the cotton now imported into Britain, a very small part, at present not more than a twentieth, is sent out unmanufactured; a larger proportion (from an eighth to a tenth) is manufactured in Scotland; the residue is all worked up in England. The total value of the cotton manufacture of Britain (cloth and yarn) is computed at somewhat more than L.30,000,000 Sterling.

The rapid rise in the general price of commodities, in the present age, has induced many to consider enhancement as the unavoidable consequence of extended commerce, and to question the accuracy of Dr Smith's opinion, that the diffusion of productive industry has a tendency to cheapen produce. But never was there a more satisfactory confirmation of the arguments of Dr Smith than in the progress of the cotton manufacture. The price paid for spinning a pound of cotton thread, which, in 1786, amounted to 10s. was reduced progressively to 8s., 6s. 8d., 4s., 3s. and 2s. 6d., not by lessening the gains of the workmen, but by a series of inventions for abridging labour; until the great improvements after 1795 led to a reduction of the spinning price to 8d. *per* lb., at which it has since continued. In like manner, the sale price of cotton yarn has progressively decreased, notwithstanding the rise in the raw material.

Price per lb. of Cotton Yarn. (*No.* 100.)

Years.	Price.	Years.	Price.
1786,	38s.	1805,	7s. 10d.
1790,	30s.	1806,	7s. 2d.
1795,	15s.	1807,	6s. 9d.
1800,	9s. 5d		

The prices have since varied from 6s. 9d. to 4s. 5d. according to the state of the trade; and amidst all these reductions, the quality of the yarn is much improved.

Value of Cotton Manufactures and Cotton Yarn Exported from Britain.

	Manufactures.	Yarn.
1814,	17,394,000	2,907,000
1815,	19,127,000	1,781,000
1816,	13,079,000	2,707,000

We add some farther particulars for one year, to show the countries which take the largest proportion of our cottons.

Export of Cotton Cloth from Britain in 1816.

	Printed Calicoes. *Yards.*	Plain Muslin. *Yards.*
To Germany, .	16,902,000	5,575,000
the Netherlands,	7,601,000	3,200,000
Portugal, .	5,725,000	1,925,000
Italy, . .	4,454,000	2,790,000
Gibraltar (as a *depot*),	5,168,000	2,157,000
Malta (ditto),	2,406,000	3,210,000
Denmark, .	571,000	445,000
Ireland, . .	146,000	123,000
India and China,	969,000	462,000
United States of America, . .	16,922,000	5,495,000
British North America,	1,988,000	344,000
Brazil, . .	7,960,000	2,800,000
West Indies and Spanish America, .	15,792,000	4,760,000

It is of importance to remark the quantity sent to Germany, notwithstanding the rival manufactures in that country. To France, our avowed exports are inconsiderable, there being a duty on the import of British cottons; but large quantities are taken off by French smugglers. The demand from the United States is at present, and is likely to continue, the greatest of all; that from Brazil is deserving of attention, as well from its steadiness as from its magnitude, when we consider that the population in that country, accustomed to wear European manufactures, does not exceed a million of souls. Gibraltar and Malta serve as *entrepôts* for the supply of the south of Spain, and other parts of the Mediterranean.

The following short table is useful, in pointing out the countries which carry on more or less of the cotton manufacture, without making the yarn (at least the whole of the yarn) themselves.

Cotton Yarn Exported to the following Countries.

	1814.	1815.	1816.
Russia, .	L. 669,000	L. 494,000	L. 408,000
Germany, .	1,600,000	857,000	1,754,000
Netherlands,	462,000	248,000	281,000
Ireland, . .	116,000	107,000	79,000
France, . .	7,780	78	978
Italy, . . .	21,752	12,495	48,302

The insignificance of the export to France, implies not that the manufacture of cotton in that country is of trifling amount, but that the French import the cotton wool direct from the countries of its growth, and manufacture their own yarn.

Loaded as we are with taxes so much heavier than those of our neighbours, it becomes a question of great interest, and anxiety, whether we are likely to maintain our superiority in this, the greatest branch of our exports? With the view of facilitating this inquiry, we shall hazard a conjectural estimate of the component parts of the cost of our cotton manufactures.

Manufactures.

Cost of the raw material, . .	L. 11,000,000
Wages of men, women, and children, in peace, . . .	8,000,000
Salaries of clerks and others, not comprised under wages, . .	1,000,000
Interest (at 5 *per cent.*) on the supposed capital invested in buildings, machinery, and mercantile credits, .	2,500,000
Annual wear and tear of the machinery and buildings, . . .	2,500,000
Profit of the manufacturers, exporters, and venders, . . .	3,000,000
Duty on raw material (about L.400,000); loss by bad debts, travelling charges, postage, and a variety of expences exclusive of the above, . .	4,000,000
	L. 32,000,000

The total number of persons employed, directly and indirectly, in the cotton manufacture of England, is computed at from 400,000 to 500,000. Machinery performs here a vast deal; and manual labour, when requisite, can be done in so many instances by women and children, that the average wages of all persons so employed, is not reckoned more than L. 15 *per* head *per annum*. The points in which foreigners have the advantage are fortunately limited to the wages and the duty; the last of which it is not impracticable, in a time of exigency, to take off. In other respects, viz. in the purchase of the raw material, the command of fuel, moderate interest of capital, machinery, and subdivision of employment, we stand either on equal or better ground. The wages form certainly a heavy drawback on our side of the question, but, on the whole, the chances in a continued competition seem to be in our favour, as our readers will see by a reference to our article on Cotton Manufacture. To the remarks there made, we have now to add, that at Paris and its vicinity, which is in part the seat of the French manufacture, the support of a workman and his family (and consequently the wages) is fully as expensive as in Lancashire, while at Rouen the difference against us is not considerable. To Switzerland, a similar argument applies, while Saxony and Austria, the other seats of continental competition, though cheaper than England, are remote from the sea, and consequently subject to a heavy carriage on the raw material.

The seats of the cotton manufacture of England are, *first*, Manchester, which takes decidedly the lead of all other places; afterwards Preston, Bolton, Blackburn, and Wigan, all situated in Lancashire. After these come several other places, partly in Lancashire, in Cumberland, and the West Riding of York. The introduction of cotton works into the last, the great seat of the woollen manufacture, is owing to the practicability of the same workmen turning, in case of need, from wool to cotton, and *vice versa*. The master-manufacturers in the cotton trade are not, as in the woollen, a host of individuals with small means, and great only from their multitude; they consist of a limited number of mercantile establishments, each possessed of considerable capital. But in other respects, the parallel is less favourable to the cotton manufacture. From its dependence on foreign demand, it bears many characteristics of a business of speculation; the workmen being at one time in great request, at another reduced to wages quite inadequate to the maintenance of their families; hence that frequent recurrence of complaint and combination against the masters.

Hardware.

We have already noticed the surprising increase in the produce of our iron mines since 1780. This increase of the raw material, joined in some cases to the command of coal in the vicinity, and in all to a facility of conveyance of coal and iron by canals, has given, in the last forty years, a great extension to our hardware manufacture. In it we take as decidedly the lead of foreigners as in our cottons; and if the ratio of increase has not been altogether so rapid, it is owing, not to inferior ingenuity in the workmen, but to radical differences in the two manufactures. In no department has the subdivision of employment been carried to so great a length; in none are its effects in cheapening production so conspicuous. Birmingham and Sheffield are the two great work-shops for our hardware; the latter is confined to iron and steel; while, in the former, not only iron and steel, but copper and brass, constitute the materials of labour. Sheffield fabricates articles which are less for ornament than utility, and which possess, in general, a certain bulk, such as grates, spades, sickles, files, knives, fenders, fire-irons; while in Birmingham there is, in addition to articles of solidity, a surprising variety of toys, fancy goods, and petty manufactures; each trifling when considered separately, but the whole forming an aggregate of great value. The most insignificant of these, such as a brass-cock or a button shank, passes through a number of hands; each artisan performing only a single operation. He thus acquires an extraordinary dexterity in his limited department, and, in the course of a day, dispatches several hundred, perhaps a thousand articles, through his particular stage, the result of all which is, that the price, when sold in quantities, is incredibly low. Another and very interesting feature in the situation of Birmingham, is the populousness of its neighbourhood. The manufacturing district, extending about sixteen miles, is estimated to contain 300,000 inhabitants, in addition to nearly 100,000 in the town. (*Committee on Repeal of Orders in Council*, 1812.) Yet in none of our large towns is living less expensive; an advantage owing partly to the abundance of coal, partly to the ready supply of milk and vegetables consequent on the wide space occupied by these extraordinary numbers.

The nail trade is carried on, not in the town of Birmingham, but in a part of the district just described; it is computed to employ 30,000 men, women, and children; for even this heavy article admits of a subdivision of employment, which lightens the labour, and enables a workman to avail himself of the aid of his family. Of the two towns, Sheffield is by much the more ancient; the command of coal and iron in the same neighbourhood having rendered it, so far back as the thirteenth or fourteenth century, a place for the fabrication of the homely articles used in

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these days by our ancestors. It is about a century since its razors, knives, and files began to take a more delicate shape. Birmingham embraced a wider range, and advanced with much greater rapidity; but Sheffield also has its adjacent district inhabited by manufacturers, though to a much less extent than the vicinity of Birmingham. This district, called Hallamshire, extends six or seven miles to the west of Sheffield.

Hardware is made in several other places, such as Wolverhampton, Dudley, and Walsall. Each of these towns is situated in Staffordshire, and, in point of manufacture, is small only in comparison with Birmingham or Sheffield. Articles, apparently very trifling, are made to a surprising extent in different places; such as pins at Gloucester; needles at Redditch in Worcestershire; watch movements and main springs at Prescott in Lancashire. The total value of our articles of iron, steel, brass, and copper, including the manufacture from its earliest to its most finished stage, is necessarily fluctuating, but may be computed at L. 15,000,000 annually; two-thirds of which appear to be consumed among ourselves, while the other third is exported to two great markets, the Continent of Europe and the United States. A return during three years of peace, but of unequal mercantile prosperity, will suffice to show the average of annual export.

Metals and Hardware Exported from Britain.

	1814.	1815.	1816.
1. Metals, as a RAW MATERIAL, or in the first stage of manufacture.			
Iron and steel, wrought and unwrought,	1,143,356	1,280,928	1,095,782
Lead and shot (partly from Scotland),	222,138	327,528	329,478
Tin unwrought,	127,290	148,624	171,886
2. MANUFACTURES in a finished state.			
Hardware and Cutlery,	1,033,235	2,349,676	1,987,092
Brass and copper manufactures,	479,517	752,611	675,004
Plate, Plated ware, Jewellery, and Watches,	200,205	284,213	302,077
Tin and Pewter wares, and Tin Plates,	236,591	324,738	331,605
	3,442,332	5,468,318	4,892,924

The number of persons, young and old, employed in our hardware manufactories, is reckoned between 300,000 and 400,000. In no branch of industry is the transition from war to peace more sensibly felt; government, the great customer for arms and artillery, withdraws entirely from the market; while the stagnation of commerce, the postponement of new buildings and new machinery, in short, the various evils inseparable from a sudden and general change, which have been so cruelly felt throughout Britain since the peace, all operate most materially against the sale of the heavier and more useful articles. Similar causes cast a damp over the purchase of ornamental and fancy goods; so that, in no department of our population have the sufferings of the labouring classes or the augmentation of the poor's rate been greater. But there is happily a point beyond which depression cannot go, the reduced price of a commodity rendering it applicable to more extended uses, and adapting it to the means of humbler customers. Iron has not been found suitable as a substitute for stone in paving the streets of the metropolis; but, if its price continue low, it is likely to supplant timber for a variety of purposes, of which the public at large are not as yet aware. Reduction of price will lead also to a demand from the Continent for our hardware; the article in which of all others the French and Germans are most behind us. Their mines of iron are seldom adjacent to their mines of coal, and, with the exception of a few places, such as Liege in the Netherlands, and St Etienne near Lyons, the hardware workmen are not collected in such large associations as to admit of the necessary subdivision of labour. As improvement advances, and a taste for comfort becomes diffused, the inhabitants of the Continent will extend their purchases; they will see in the keys, the locks, and other neat and convenient articles of English fabric, a substitute for the bolts, the latches, and other coarse contrivances, with which they have hitherto been obliged to content themselves. In the United States, iron and coal are found, it is said (Mellish's *Travels in America*, chap. 67), in abundance, in a quarter (Pittsburgh in Pennsylvania) where land and provisions are certainly much cheaper than in Britain; but the scattered state of American population must, during several ages, oppose serious obstacles to the division of employment necessary in all the nicer branches of the hardware manufacture; particularly as the ease with which the Mississippi and Ohio are navigated by steam, opens even the western states to the import of British goods. On the whole, therefore, we look on our hardware manufactures, notwithstanding their present depression, as resting on a solid basis, because in them we combine several advantages;—the raw material, the command of cheap fuel, and the use of machinery, which, the more it is adopted, will bring a greater proportion of the work within the compass of women and boys, and thus lessen the proportion borne in the cost of the finished article by wages.

Linen Manufacture.

Linen has never formed one of the staple manufactures of England, flax having been less cultivated among us than on the opposite shore of the Netherlands; a country which, in the fourteenth and fifteenth centuries, supplied the rest of Europe both with the finest linens and woollens. When England subsequently advanced in manufacturing arts, the abundant supply of wool pointed out the most suitable branch; and we were contented to continue our imports of linen from the Netherlands, from France and

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from Germany, or to favour the manufacture of the sister island in a department which did not excite our jealousy. In Ireland, the linen manufacture dates about two centuries back, and is said to have owed much of its extension to the measures of the unfortunate Wentworth in the reign of Charles I. The annual consumption of linen in England a century ago, was probably not far below that of her double population at present; owing to the very general substitution in our time of cotton articles. Then, as at present, the linen manufacture of England was established chiefly in Lancashire, in Cumberland, and in a county very remote from these—Dorsetshire. In 1745 government, apprised of the extension of the manufacture of coarse linen in Silesia and other parts of Germany, and actuated by the fallacious notion of making a monopoly of all kinds of productive industry, granted a bounty of 1½d. *per* yard on the export of all British linen of a value from 6d. to 18d. *per* yard; in other words, a premium of 20 or 25 *per cent.* on the prime cost of all inferior qualities exported. So large a grant soon augmented the manufacture of Osnaburgs and other coarse cloths, particularly in Scotland, although the ratio of increase was infinitely smaller than in the case of cotton, where there was no premium but a rapid improvement of machinery. The demand for bounty, in the ten years ending in 1785, was about L. 33,000 annually. Since that time these impolitic issues have greatly increased, and of late years above L. 100,000 has been paid for bounty on linen and canvas exported from England and Scotland.

The following returns from the Customhouse books show the extent to which we are dependant on foreign countries for a supply of the raw material; and on countries too which have linen manufactures of their own:

Linen Yarn.—Foreign imported into Britain in

	1814. cwt.	1815. cwt.	1816. cwt.
Russia,	5,780	323	220
Germany,	39,980	39,879	9,466
Other parts,	166	994	5
	45,926	41,196	9,691

Flax Imported into Britain.

	1807. cwt.	1810. cwt.	1815. cwt.	1816. cwt.
Russia,	372,000	473,000	20,000	9,000
Prussia,	7,500	20,000	15,000	880
Holland,	34,000	1,000	73,000	58,000
Other parts,				
	416,000	511,000	326,000	213,000

Into Ireland, on the other hand, the importation of foreign flax is almost nameless, seldom amounting to 100 tons.

The late war gave considerable vigour to our sail-cloth and cordage manufactures at Bridport, Lancaster, Workington, &c. the great source of supply was from Scotland; the manufacture of canvas for the navy having been carried on extensively in that part of the kingdom, particularly on the east coast. The average value of the linen of all kinds made in England hardly exceeds a million a-year; and if we wish to contemplate this fabric in a state of extension and prosperity, our view must be directed to Ireland, where, without any aid from government, the manufacture of fine linen has continued progressively to augment, and has obtained the command of the market of England, reducing our imports from the Continent to a very small comparative proportion.

	Yards.
Average import of Irish linen into England for home consumption in the 12 years from 1800 to the end of 1812,	32,800,000
Ditto from Germany, also for home consumption, about	2,000,000
Ditto from Russia, nearly	2,000,000

A similar superiority in favour of Ireland is proved by the Customhouse returns for years of peace.

	1814. Yards.	1815. Yards.
Plain linen of Germany and Silesia retained for home consumption, about	600,000	300,000
Russia,	2,300,000	330,000
Ireland,	29,864,000	31,026,000

Having thus shown the mode of supplying the home consumption in the only great article of manufacture which England does not make for herself, we are next to convey an idea of our exports. This will be best done by two extracts from the Customhouse returns, the first for the linens of England and Scotland, exclusive of those of Ireland.

British Linens Exported.

To	1812. Yards.	1814. Yards.	1815. Yards.
Continental Europe,	4,328,000	2,807,000	980,000
E. Indies & Asia,	69,000	101,000	33,000
United States,	458,000	(war)	2,275,000
British N. America,	183,000	736,000	977,000
British W. Indies,	6,613,000	10,147,000	10,879,000
Foreign W. Indies,	1,789,000	4,255,000	1,510,000
Other parts,	547,000	706,000	529,000
	13,987,000	18,752,000	17,183,000

(See *Customhouse Returns*, 5th April 1816.)

To these is to be added an export of canvas to the amount of about a million of ells annually, which goes chiefly to our North American and West India Colonies. The finer linens exported, viz. those above 10d. *per* yard, are not entitled to bounty. We come next to a more comprehensive table—to our linen exports generally.

Export of Linen Manufactures from Great Britain.

Years.	Value real not official.
1814,	L. 1,732,691
1815,	1,828,203
1816,	1,476,143

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Of these a large proportion is of Irish manufacture.

It remains to add a few words in regard to the transit trade of England in foreign linen. This subject was, so lately as 1817, brought under the consideration of Parliament, and arguments of weight were offered for taking off the duty, collected for many years back on the German and Russian linen which passed through this country. Government, however, persisted in retaining it; less, in all probability, with a view to revenue, than to prevent foreign linens from rivalling British in the supply of our colonies.

Silk Manufacture.

In the silk manufacture, as in linen, we have had to contend with established manufacturers in other countries, particularly in France and Italy. We have had also to import the whole of the raw material. Such a manufacture was, therefore, unsuited to England, and would not have been attempted by our countrymen, but for the great profits expected from an article of general use among the higher classes. Its introduction among us goes back to the fifteenth century. About the beginning of the seventeenth, it seems to have been carried to a considerable extent, owing certainly not to the luxury of the age, or to any great proportion of affluent persons in the community, but to silks being almost the only article of apparel in which the vanity of dress could display itself. Towards the end of the reign of Charles II., about the year 1680, raw silk began to be imported in quantities from India; and the English manufacture received a substantial addition by the numbers and ingenuity of the Frenchmen who settled in this country, after the revocation of the edict of Nantes in 1683. Various circumstances thus contributed to preserve, and even to extend the silk manufacture; and, as our rate of wages did not then materially exceed those of our neighbours, it seems to have experienced no great or general shock till the rivalship of cotton, after the surprising improvements introduced into that branch, between 1785 and 1795; but such was that rivalship, that it became in vain for the East India Company to increase their imports of silk, or to introduce, as they did at this period, into Bengal the Italian method of winding it. Nothing could counterbalance the cheapness and elegance of the new substitutes; and the weavers of Spittalfields became reduced to that penury, which, with few exceptions, has continued their lot ever since. It was a radical error to attempt establishing a great manufacture in London, where provisions, fuel, and house-rent, are necessarily higher than in the country. Accordingly, Coventry, Leek in Staffordshire, Macclesfield in Cheshire, Manchester, and other places, proved successful rivals to the metropolis. The present distress of the workmen in Coventry appears, by a very circumstantial exposition,* to be greater than has for some time existed in Spittalfields; but any superiority in the latter must be but temporary, and must arise from the operation of the poor's rate, or from the regulation of wages by act of Parliament.

The persons, young and old, employed in the silk manufacture in London, are computed at about 25,000; the number in all the provincial towns about 40,000; but the total value manufactured, in an article of such price, exceeds the proportion suggested by these numbers. It is calculated at L. 4,000,000 Sterling a-year; an amount which is probably within one-fourth of the most flourishing state of the manufacture about the year 1785; and the magnitude of which, notwithstanding the general adoption of printed cottons, is chiefly to be accounted for from our augmented population.

The following years are selected to show the periodical variations in the supply of silk from different countries:

Years.	Raw Silk from Bengal.	Ditto from China.	From other Countries, chiefly the South of Europe.	Thrown Silk imported.
	lbs.	lbs.	lbs.	lbs.
1807	513,823	55,277	208,699	346,144
1809	164,100	90,603	443,486	501,746
1812	986,178	86,197	257,731	617,885
1816	764,663	88,987	92,142	192,130

Bengal has thus gained greatly over the south of Europe. In an article of such value for its bulk, the freight even from India is of little consequence; but there is another and a more substantial reason in the difference of duty. Raw silk from Bengal pays on warehousing only 5d. *per* lb., and 3s. 9d. additional when entered for home consumption; raw silk from China is taxed considerably higher; and that from other countries is no less than 5s. 6d. *per* lb. Each are entitled to a drawback, when re-exported in a manufactured state.

Export of Silk Manufactures from Great Britain.

Years.	Value, real not official.
1814,	L. 624,749
1815,	692,929
1816,	533,374

The chief vent for our silks is to our North American colonies, the West Indies, and Portugal; also to Ireland; but to the United States comparatively little, for we have never been able to rival the French in this manufacture.

The Leather Manufacture.

Leather, however little it may figure as an article of export, is necessarily one of extensive home consumption in every civilized country, particularly in such a climate as ours; and it is matter of regret, that we should have so very few *data*, official or otherwise, on which to form an estimate of the export or import of hides in former ages. Such an estimate would possess interest, as indicating the extent of our pasturage and the number of our cattle in comparison with our population. Whatever may have been the case at a remote date, the customhouse returns, for many years back, show by the annual imports, that the demand for leather has ex-

* Debate in the House of Commons, May 1819, on the state of the silk manufacture of Coventry.

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ceeded the home supply of hides. For a long time this importation took place from the continent of Europe, and from the least civilized quarters; from countries, such as Lithuania and Poland, where the quantity of hides furnished by the cattle materially exceeds that of the leather required by the inhabitants. But since the opening of South America, particularly in 1807, it has been found advantageous to import hides from that continent, where the herds of wild cattle are so numerous as to meet the eye of the traveller in almost every point of the horizon.

Account of the Number of Raw Hides imported from various Countries into Great Britain during the years 1814 *and* 1815.

	1814. Number.	1815. Number.
Continent of Europe,	148,730	161,362
Ireland, and the Isles Guernsey, Jersey, and Man,	30,838	30,111
East Indies,	742	10,819
Africa,	55,885	56,962
America (chiefly South America),	541,979	783,171
West Indies,	46,031	20,460

The quantity of hides tanned in England and Wales is computed at nearly 9,000,000, weighing about 350,000 cwt. The largest tanneries are in Bermondsey in Southwark; but there are also very extensive establishments of the kind in the country,—in Cheshire, Lancashire, Westmoreland, Cumberland; also in Lincolnshire. The late war, by its long continuance, and the magnitude of our army and navy, produced great orders from government for our leather manufacture. Shoes were and still are made wholesale, in several towns of Staffordshire, Cheshire, and Northamptonshire. In this, as in other departments of manufacture, we suffer materially by our high wages, shoemaking on the Continent being considerably cheaper; but here also the spirit of invention has been active; and we have lately been informed, that, in the neighbourhood of London, machinery has been applied to what has hitherto been thought indispensably to require manual labour.

Of the annual value of our leather manufactured into shoes, boots, harness, saddlery, &c. there are no means of forming a correct estimate; but we have merely to consider the population of England, and the unavoidable extent of their wants, to be satisfied, that from ten to twelve millions sterling are rather below than above the mark. But while our home consumption is so considerable, our export is comparatively small, and does not exceed half a million sterling. To Ireland, the leather we ship is merely tanned; to other countries our exports are in a manufactured shape.

The increased duty imposed on leather towards the close of the late war, has been the subject of much discussion. This duty was brought forward in Parliament in the spring of 1813. It was evidently liable to the most serious objections, from increasing to the lower orders the expence of an indispensable article, and raising to farmers and others the price of harness and saddlery. Accordingly, the tanners, the leather-merchants, and the various classes affected by it, created an opposition which had well nigh defeated the bill. It was, however, carried, and has been continued without diminution since the peace. Its produce is nearly L. 280,000 above the old tax, as is shown by a return from the Excise-office, dated 5th March 1818; from which it appears that the five last years of the old duty, viz. from 1807 to 1811, both inclusive, amounted to . . . L. 1,460,436

Five years of the new duty, leaving out the year 1812, and reckoning from 1813 to 1817, both inclusive, . 2,842,480

The Glove Trade.

Connected with our general manufacture of leather is the Glove Trade, a branch of no inconsiderable extent, being carried on in several of our midland and western counties, viz. at Woodstock, Worcester, Ludlow, Hereford, Yeovil in Somersetshire, &c. The exports being chiefly to the United States, this branch of industry suffered severely from the war in 1813 and 1814. Nor has it by any means recovered its prosperity since the peace.

The Brewery.

We come next to a branch of industry of a very different description—the Brewery. The amount of capital and labour, invested in brewing establishments in England, is very large, and particularly striking to those who have lived on the Continent, and have contrasted our situation with that of the wine countries of the south of Europe. It is only in Flanders and Germany that breweries are numerous; and, in the latter, from the limited capital, and the scattered state of their population, there are hardly any of those large establishments which exist in our metropolis. In London, this important branch of business is chiefly in the hands of eleven great houses, who, conjunctly with the smaller establishments, brew on an average 1,700,000 barrels of porter. (*Excise Return*, 15*th May* 1818.)

Quantity of Barley made into Malt during Ten Years of War.

Years.	Quarters of Barley.
1804,	2,817,285
1805,	2,792,923
1806,	3,435,990
1807,	3,114,020
1808,	2,800,787
1809,	2,851,598
1810,	3,035,401
1811,	3,349,760
1812,	2,332,336
1813,	2,797,741
1814,	3,263,785
——	2,962,875

In peace the average is comparatively higher in beer from the cheapness of barley, and in spirits from the exclusion of sugar from the distillery.—

Computing the whole barley made into malt in England in peace, at an average of	3,300,000 qrs.
And supposing the distilleries in England to require . . .	300,000
Remains for the breweries .	3,000,000

Manufactures.

Spiritous Liquors.

Spiritous liquors form one of the great branches of manufacture in which England is dependant on her neighbours; as she imports an annual supply of corn spirit from Scotland and Ireland, rum from the West Indies, and brandy from France. During the distress of the West India planters, particularly in 1807, 1808, and 1811, Committees of Parliament were appointed to inquire into the expediency of substituting sugar for barley in the distillery, and a great deal of useful information was the result of their researches. The consumption of British spirits in England was computed at nearly . . . . . . 5,500,000 gal.

Of which distilled in England nearly	4,200,000
Brought from Scotland . .	826,000
Ditto from Ireland	470,000

(*Distillery Committee of* 1808, Evidence, p. 54.)

In the subsequent years Ireland fell off greatly in her supply of spirits, but Scotland, on the other hand, increased.

Spirits imported into England from Scotland and Ireland in the three years ending 5th April 1815, 1816, 1817. (*Return to Parliament*, 1817.)

Years.	Scotland. *Gallons.*	Ireland. *Gallons.*
1815	1,748,351	428,933
1816	1,360,380	283,621
1817	1,262,539	20,069

Notwithstanding the great increase of distillation in Scotland, there seems to have been no diminution in that of England; the return of the excise duties from 1807 to 1815 being from L.1,500,000 to L.2,000,000, while the latest accounts, we mean those of the year ending April 1818 and April 1819, are far from indicating a diminution.

Of rum the consumption in England varies with the price of British spirits and several other causes, but averages from 2½ to 3 millions of gallons. (*West India Committee*, July 1807, p. 71.)

Import of foreign Brandy (*stated in gallons*) *during three years of War.*

Years.	France.	Spain.
1805	2,663,000	405,000
1806	1,418,000	263,000
1807	2,167,000	156,000

Import into England of Rum, Brandy, and other Liquors (*exclusive of Corn Spirits from Scotland and Ireland*), *in three years of Peace.*

	Gallons.
In 1815 .	8,832,776
1816 .	7,966,052
1817 .	5,240,436

The Lesser Manufactures,—Glass, Hats, Pottery.

To the remaining manufactures our limits allow of little space, though several of them would be accounted of great importance in any other country than England. The extent to which such articles, as soap and paper, are made among us, is amply shown by the Excise Returns; but the list of our exports is of more consequence to the political economist; not from the vulgar notion, that it is by export only that national profit is realized, but as indicative of those commodities for which we possess, in our soil, our climate, or our colonial possessions, advantages that give us a superiority over our neighbours. Thus, in the case of glass, the abundance and cheapness of our coal outweigh our higher wages, and enable us to make an annual export of between L. 600,000 and L. 700,000. In the manufacture of hats, likewise, our command of wool for the coarser kind, and of furs from our North American colonies for beaver hats, enable us to ship to an extent of L. 300,000, L. 400,000, or L. 500,000 a-year. In earthenware we have the advantage of clay, of fuel, and of ready communication by canals. These, joined to the taste and ingenuity of individuals engaged in the manufacture, carried it, in the course of the eighteenth century, to an extent that has rendered it a national object; a tract of seven or eight miles in Staffordshire, called the Pottery District, being almost entirely appropriated to it. The population of this tract is about 40,000. The great outlet is Liverpool, and the shipments take place partly to the United States, partly to the Continent of Europe. Our exports, comprising Porcelain, average from L. 500,000 to L. 600,000.

The stocking manufacture is carried on chiefly in the counties of Nottingham, Derby, and Leicester. It formerly employed vast numbers of women in knitting; but in this, as in other branches, machinery has greatly superseded manual labour. Lace is made in large quantities in the midland counties; and here also machinery has of late years been extensively applied. All its aid, as well as that of protecting duties, is necessary to maintain a competition with the neighbouring shores of the Continent, where lace-making is the chief employment of the females, and where a young manufacturer thinks herself sufficiently recompensed with sixpence a-day, while the pay of an experienced one seldom goes beyond a shilling.

General Observations and Tables.

After this account of particular manufactures, it remains to add a few general statements relative to this great department of our national industry. To point out those of our counties that take the lead as the seats of manufacture, we subjoin the following return:

Counties remarkable for Trade or Manufacture.	Number of Families so employed.	Return under the Property-Tax of Annual Profits from Trade, Manufacture, and Professions in these Counties. L.
Middlesex, .	135,400	13,420,000
Surrey, includ. Southwark,	35,160	1,623,000
Yorkshire, . .	110,000	1,840,000
Lancashire, . .	114,500	1,800,000
Somerset, . .	23,700	1,296,000
Stafford, . .	34,000	495,000
Gloucester, . .	30,000	365,000
Nottingham, . .	19,000	310,000
Cheshire, . .	23,000	276,000
Durham, . .	17,000	237,000
Wales,—Glamorgan,	8,000	132,000

Manufactures.

The whole number of *families* in England and Wales employed in trade, manufactures, and professions, was, by the return of 1811, 959,622. Their total income, L. 32,210,600. To discriminate the persons engaged in trade from those engaged in manufacture, would not be easy; the above numbers being taken from the returns under the Population Act, which make no distinction between the two. The money return is for the year 1810, and indicates a rate of annual income, which, although below the vulgar estimate of mercantile profit, and considerably below the amount anticipated by Mr Pitt on first proposing the income-tax in 1798, is, we fear, above the actual rate of such profits at the present day.

An idea of the relative extent of capital and labour employed in each manufacture, will be best conveyed by the following table:

Excise Duties paid in Great Britain in the twelve months ending 5th April 1819, in British Produce and Manufactures.

British spirits,	L. 3,210,959
Malt,	3,006,143
Beer,	2,718,018
Hops,	107,510
Licences,	683,320
Salt,	1,518,498
Tobacco and snuff,	1,470,692
Soap,	845,627
Leather (hides and skins),	615,331
Glass,	497,611
Paper,	486,971
Printed goods,	433,902
Bricks and tiles,	319,571
Candles,	299,383
Starch,	51,241
Lesser articles of British manufacture, as vinegar, cider, &c.	88,959
Total of the excise duties from British produce and manufacture,	L. 16,353,736
The remainder of the excise arises from public auctions,	267,070
Or from foreign articles, as tea,	3,097,746
Wine,	1,137,311
Foreign spirits (chiefly brandy),	2,159,922
Coffee and cocoa,	110,030
Total,	L. 23,125,815

The above affords the best means of judging of our home consumption of manufactures: of our export, a collective view is given in the following table:

Manufactures. Exports.

Exports from Great Britain.

	Year 1814. L.	1815. L.	1816. L.
Cotton manufactures,	17,393,796	19,127,266	13,078,794
Cotton yarn,	2,907,276	1,781,077	2,707,385
Woollen manufactures,	7,569,507	10,198,334	8,404,481
Iron and hardware,	3,442,332	5,468,318	4,892,924
Linen manufactures, chiefly Irish,	1,732,791	1,828,203	1,476,143
Silk manufactures,	624,749	692,929	583,374
Haberdashery and millinery,	500,034	603,585	498,040
Glass of all sorts,	658,871	779,070	782,770
Leather wrought and unwrought,	573,639	582,821	403,236
Saddlery and harness,	81,907	126,112	115,854
Earthenware of all sorts,	463,900	716,222	637,201
Hats, beaver, and felt,	320,237	303,692	247,191
Hats of all other sorts,	144,318	115,179	69,998
Refined sugar,	3,260,444	2,942,042	2,153,476
Beer and ale,	315,863	384,534	351,007
Salt,	263,813	224,114	152,619
Lesser articles of produce and manufacture,	6,344,638	6,161,877	5,490,053
	46,598,015	52,035,375	41,994,546
It being customary to include our exported produce in the same return as our manufactures, we subjoin the former to complete the table.			
Coals and culm,	418,626	465,581	425,305
Beef and pork salted,	349,073	231,519	166,526
Fish of all sorts,	485,739	484,970	368,870
Total of British produce and manufacture,	47,851,453	53,217,445	42,955,256

We are next to compare these large sums with the inferior amounts of former years. The customhouse returns form here also our guide, and though our produce exported is included in the amounts, by far the greater part consists of manufactures.

Export of produce and manufacture from Great Britain, on an average of six years, ending with	1792,	L. 22,131,000
Average of six years, ending with	1798,	25,658,000
Ditto, ending with	1804,	36,817,000
Ditto, ditto,	1810,	43,575,000

These sums are formed by adding 50 *per cent.* to the official estimate. In peace, a partial reduction takes place in the price of most merchandise, and we adopt a scale of valuation somewhat lower, by taking the value as declared by the exporting merchants.

Exports since the Peace.

Years.	Declared Value.
1814,	L. 47,851,453
1815,	53,217,445
1816,	42,955,256
1817,	43,626,253
1818,	48,903,760

This is, of course, exclusive of the foreign and colonial merchandise exported each year.

Such are the principal facts in regard to the manufactures of England—the department of our productive industry which, of all others, has most conspicuously displayed the inventive powers of the na-

Commerce, &c.

tion, and most largely contributed to the unparalleled burdens of the late wars. In this age of rapid enhancement, manufactures present a striking exception to the general rule; for, while land, houses, fuel, corn, cattle, in short almost every thing else, has risen in price, manufactures have fallen, and fallen greatly. That this should have taken place in spite of the rise both of wages and materials, is to be ascribed altogether to mechanical inventions; the extent of which has been such as to render it not improbable that, in some fabrics, such as cotton, one person can now make, in a day, as much as, half a century ago, could have been made by a hundred. A writer, whose views, both on the practice and principles of trade, are entitled to attention,* has lately exhorted us to make a considerable change in our mercantile code;—to forbear all attempts at a monopoly of manufacturing industry, and direct our capital and labour altogether to those branches, such as hardware, woollens, and cotton, in which we possess local and permanent advantages. The principle of this reasoning is incontrovertible, but its practical application should be a work of great care and caution; for were we at present to throw open our ports to the import of goods manufactured abroad, our countrymen would emigrate by thousands to the Continent, for the mere purpose of labouring in untaxed countries for the supply of the British market.

VIII.—*Commerce and Shipping.*

Much of what relates to the *Commerce* of England has been already treated under the preceding section; and the colonial part of our trade shall be noticed in the next: At present, we are to exhibit a brief sketch of our commercial intercourse with Ireland and the Continents of Europe and America.

With Ireland, the intercourse of England is very great; that country sending us linen, cotton, salted provisions, and butter, to the amount of six or seven millions annually, and taking largely, in return, our manufactures, particularly cotton, woollen, and hardware.

North of Europe.—From Russia, our chief imports are hemp, flax, linen, timber, pitch, and tallow; from the Swedish dominions, iron and timber; from Poland, wheat, timber, and potash; from Prussia, wheat, timber, and flax. All these countries take our cottons, hardware, and colonial produce.

Central part of Europe.—From Holland, our imports are not foreign merchandise, as in the seventeenth century, when the Dutch were the carriers of Europe, but agricultural produce,—oats, wheat, seeds, hemp, cheese, butter; also gin; the whole to a large amount: in return for which the Dutch take our hardware, cottons, and woollens. From France, our imports have long been burdened with heavy duties; still they are large and increasing; consisting chiefly in wine and brandy, and, in a smaller degree, in silk and lace. With Germany, our chief intercourse is through the medium of Holland and Hamburgh. Our exports are large, particularly in cottons, hardware, and colonial produce. Our imports are very various, partly of corn, flax, timber, linen, and wine, from the vicinity of the Rhine.

Commerce, &c.

South of Europe.—Here we enter on countries of much less industry. From Portugal we take wine in very large, and fruit in smaller quantities, in return for our cottons, our woollens, and hardware. From Spain, wool is the great commodity received; wine, brandy, oil, are imported in lesser quantities. Italy, without any commercial treaty, takes annually a portion of our manufactures, and gives in return silk, oil, and fruit. With the Levant, our traffic is similar, consisting in an export of manufactures, particularly printed cottons and hardware, and of an import of silk, fruit, and drugs.

The *United States* are, notwithstanding our political antipathies, our best customers, receiving from us manufactures of almost every kind, to a great amount, and sending us, in return, cotton, tobacco, rice, and flour. But the merchandise received from them being far inferior to the value of our exports, the difference is paid by remittances in money, from the Continent of Europe, arising from American merchandise sold there. With South America, a wide field of commercial intercourse will ere long be opened; at present, the chief articles received from that vast region are, cotton, hides, indigo, and cochineal. The trade is, and will long be, subject to the various disadvantages of a newly-settled country, bare of capital, deficient in industry, and possessing but a small number of consumers of European commodities in proportion to its extent and fertility.

Having, in the preceding section, given the exports of British produce and manufactures, it remains to give those of colonial and foreign produce. To convey an idea of the relative value of different articles annually exported from Great Britain, we select a particular year.

Export of Foreign and Colonial Produce in the year 1816.

Cotton,	L.343,768
Hides, raw and tanned,	212,396
Indigo,	829,130
Logwood,	111,238
Pepper,	424,365
Piece goods of India,	1,419,232
Rum,	824,820
Sugar, raw,	1,594,635
Tea,	546,701
Tobacco,	259,141
Wines,	220,789
All other articles,	7,759,718
Total,	L.14,545,933

* *Observations on the Principles of the Commerce in Grain*, by Dugald Bannatyne, Esq. 1816.

Commerce, &c.

We shall next show the average annual amount since the beginning of the late wars.

Average of the Export of Colonial and Foreign Produce from Great Britain during periods of Six Years:

	Real Value.
From 1793 to 1798,	L.10,756,875
—— 1799 to 1804,	14,525,000
—— 1805 to 1810,	13,012,916

To exhibit a comprehensive view of the export of both foreign and domestic merchandise, we add

Average of the Total *Exports from Great Britain in periods of Ten Years.*

	Real Value.
From 1761 to 1770,	L.21,652,650
—— 1771 to 1780,	21,173,700
—— 1781 to 1790,	27,769,100
—— 1791 to 1800,	40,890,300
—— 1801 to 1810,	52,846,800

Since the peace, the total exports have been as follows; taking British goods at the value declared by the merchants, and adding, in the case of foreign or colonial goods, 25 *per cent.* to the official value:

Years.	Value real, not official.
1814,	L.73,488,758
1815,	74,371,819
1816,	61,137,711
1817,	58,032,406
1818,	64,262,852

Proportion of our Exports sent to different parts of the World.

To exhibit this, we take the exports, not of recent years, in which commerce has experienced such rapid transitions, but of 1807, the last year during the war, in which neutral intercourse was undisturbed.

	Real Value.
To Ireland,	L.7,032,272
To the Continent of Europe,	15,420,514
To the East Indies and China,	3,555,392
To the Cape, and the rest of Africa,	1,022,745
To the United States,	12,097,942
To the West Indies and other parts of America,	11,353,796
	L. 50,482,661

For the distribution of our commerce in a year of peace, see the tabular statement of shipping for 1816.

Our imports excite much less attention than our exports, being apparently less intimately connected with that productive industry which affords a national surplus, and favours the popular notion of our extracting an annual revenue from our neighbours. They are, in general, from ten to twelve millions below the amount of our exports; a difference which was long, and still is, considered by many to indicate the amount of our annual gains; it being supposed that the excess of our exports constituted a favourable balance, which was remitted to us in money or bills of exchange. But money and bills of exchange are sent abroad as well as remitted, and had our metallic currency been in reality swelled by these successive importations during the last century, it would, ere this, have amounted to L. 400,000,000 Sterling. The Bullion Committee of 1810, aware of the fallacy of this notion, and desirous to arrive at as great a degree of certainty as was practicable in so complicated a calculation, obtained from the Inspector-general of our imports and exports a computation, in an amended form, of the balance of trade. This estimate * exhibits an apparent favourable balance of L. 8,000,000 or L. 9,000,000 Sterling; but is evidently defective in some very material points, particularly in taking no notice of government remittances for garrisons abroad.

A list of bankruptcies forms an unpleasant part of our mercantile picture, particularly as their number is found regularly to increase with the extension of our commerce.

	No. of Bankruptcies.
In 1703, there were only	30
1753,	214
1763,	233
1773,	562
1783,	528
1793,	1,304
1816,	2,442

If, as we believe, a large proportion of these failures has been owing to political convulsions, and to the indirect effect of the usury laws (See Art. COMMERCE, pp. 281, 282), we are not without hopes that settled peace, and a change in the laws in question, may materially improve this distressing part of our mercantile situation.

Shipping.

The following is a statement of the progressive increase of English Shipping:

Years.	Tons.
1663,	95,266
1688,	190,533
1701,	273,693
1715,	421,431
1737,	476,941
1751,	609,798

In the following years the shipping of Scotland is included:

1765,	726,402
1774,	901,016
1785,	1,074,862

We have selected years of peace, because in war the necessity of resorting to neutral flags generally causes a diminution of British shipping. The above column expresses the tonnage, not as permanently registered, but as entered in the Customhouse books on the outward clearance of vessels.

On coming nearer to our own times we possess more satisfactory documents; viz. the Tonnage and

* Appendix to the *Report of the Bullion Committee,* p. 228.

ommerce, &c.

Seamen permanently registered in England, exclusive of Scotland, Ireland, and the Colonies, from the Customhouse returns on 30th September each year.

	Tonnage.	Seamen.
1792,	1,186,610	87,569
1800,	1,466,632	105,037
1812,	1,951,234	124,896
1813,	2,029,637	127,740
1814,	2,088,204	131,078
1815,	2,139,301	135,006
1816,	2,152,968	134,060

We add for one year (30th September 1817) the total tonnage and seamen belonging to the British empire.

	Tons.	Seamen.
England, Scotland, and Ireland,	2,397,655	152,352
Guernsey, Jersey, and the Isle of Man, ...	23,689	3,190
Colonies, ...	243,632	15,471
Total,	2,664,976	171.013

hipping in 816.

Number of Vessels, with their Crews, which entered British Ports during 1816, *including their repeated Voyages in the course of the year.*

From	British Vessels. Ships.	British Vessels. Men.	Foreign Vessels. Ships.	Foreign Vessels. Men.
Russia, . . .	600	5,687	56	837
Sweden, . .	65	603	73	768
Norway, . . .	130	1,005	177	1,598
Denmark, . .	41	280	34	235
Iceland, . .	—	—	—	—
Germany, including Prussia,	988	7,951	191	1,882
Holland and Flanders, .	1,148	7,286	556	2,619
France, . .	1,522	9,286	1,294	8,829
Portugal, Azores, and Madeira,	437	2,735	39	340
Spain and the Canaries, .	302	2,053	58	503
Gibraltar, . .	36	331	—	—
Italy, . .	175	1,554	6	60
Malta, . .	17	220	—	—
Ionian Islands, .	14	135	—	—
Turkey and Levant, .	26	247	—	—
Total of Foreign Europe,	5,501	39,206	2,484	17,671
Ireland, . .	7,575	33,814	27	291
Isle of Man, . .	636	1,656	—	—
Guernsey, Jersey, and Alderney,	788	3,617	5	36
Total of British Europe, .	8,999	39,087	32	327
Asia (India and China), .	116	8,737	—	—
Africa, . .	42	444	—	—
United States of America, .	175	2,194	305	4,170
British North American Provinces,	783	8,788	—	—
The West Indies, .	773	12,456	—	—
Spanish and Portuguese America,	190	2,093	4	85
Total of America, . .	1,921	25,531	309	4,255
The Whale Fisheries, .	175	6,774	—	—
Grand total, . .	16,754	119,779	2,825	22,253

The total of British shipping thus employed was nearly 2,000,000 tons; that of foreign nations only 318,000. The chief cause of this great superiority lies in our exclusive navigation to the East and West Indies; but as this proceeds in a great measure from our navigation laws, it is fit to look abroad and to compare our numbers with those of other nations in the comprehensive record kept in the entrance to the Baltic. The number of British vessels that entered the Sound in the year 1817 was 2088 out of 6758. In tonnage we bore a still larger proportion, perhaps the half of the whole, the majority of other vessels (Swedish and Prussian) being of inferior size.

Commerce, &c.

As the preceding table does not include the coasting trade, we annex a computation of the number of vessels employed in that department of our navigation.

	Vessels.
From the whole of the Out-ports to the Port of London, ...	700
From Newcastle, Sunderland, and Blythe, with coals to London, . . .	450
Vessels in the Coal trade to other ports from ditto, ...	470
Vessels employed from Whitehaven and other ports in the Coasting Coal Trade, .	250
Vessels employed in conveying produce and merchandise to and from one Out-port in the United Kingdom to another, about	1130
Total,	3000*

Of these vessels the half in tonnage, if not in number, belong to the coal trade. Of the value of the merchandise or property thus transmitted, there are at present no means of judging; it being exempt from duty, and a great part of it either uninsured or covered in such a manner as not to come under the policy duty.

The shipping interest have long complained of the decay of ship-building, but an accurate inquiry was made in 1806, which showed, that whatever might be the case in regard to our southern dock-yards, the northern had increased their business, and that, on the whole, there was an augmentation. The returns made to government exhibit an instructive example of the migration of industry according to the price of living. The following Table shows a decrease:

	Tons of Shipping built in the two Years 1790 and 1791	Tons of Shipping built in the two Years 1804 and 1805
London, .	16,372	12,680
Bristol, .	3.071	1,623
Liverpool, .	6,710	4,154
Rochester, .	1,342	1,087

But the case is very different in the ports remote from the metropolis.

Sunderland,	5,951	14,198
Hull, . .	8,193	10,839
Newcastle, .	12,444	15,054
Berwick, . .	481	1,690
Whitehaven, .	3,630	6,750

* Colquhoun *on the Resources of the British Empire.*

Colonies, &c.

Ship-building is carried on extensively in other ports, particularly at Whitby and Scarborough.

Total Tonnage of Ships built in Great Britain and Ireland.

	Vessels.	Tonnage.
1791,	720	65,000
1805,	740	80,000
1814,	706	86,075
1815,	913	102,943
1816,	851	84,676
1817,	758	81,263

Of this tonnage, about three-fourths is built in England, and the remainder chiefly in Scotland, very little ship-building having as yet taken place in Ireland.

IX.—*Colonies and Foreign Dependencies.*

The colonies and dependencies of England in the four quarters of the globe are,

EUROPE.

Guernsey, Jersey, Isle of Man, Gibraltar, Malta, Heligoland.

AFRICA.

Cape of Good Hope, Sierra Leone, Cape Coast, St Helena.

ASIA.

India,
Ceylon,
Prince of Wales's Island,
Bencoolen,
Isle of France,
New South Wales, or Botany Bay.

AMERICA.

Continent.—Canada, Upper and Lower,
New Brunswick,
Nova Scotia.
Islands.—Cape Breton,
St John's,
Newfoundland,
Bermuda.

THE WEST INDIES.

Jamaica,
The Leeward Islands,
The Windward Islands,
The Bahamas,
The Virgin Islands,
On the Continent.—Demerara, Essequibo, Berbice, Honduras.

North America.—Our exports to our North American colonies (see the account of CANADA, Vol. II. p. 599) vary from one to two millions Sterling. Our imports from Canada consist of furs and skins to a large amount. From Nova Scotia and New Brunswick the chief article received is timber; from Newfoundland, fish and seal skins. A great traffic is carried on between our West India and our North American colonies; the fish, flour, and staves of the one being exchanged in great quantities for the rum, the coffee, and the sugar of the other.

Shipping employed between Great Britain and her North American Colonies.

	Ships.	Tons.	Men.
1805,	288	52,412	2,707
1814,	392	81,939	4,277
1815,	672	145,448	7,241

West Indies.—*Imports into Britain from, and Exports to the West Indies, both in official value.*

Years.	Imports.	Vessels entered Inwards. Ships.	Vessels entered Inwards. Tons.	Exports.
1763	2,349,006			1,154,109
1773	2,836,093			1,335,773
1783	2,891,805	614	124,239	1,796,982
1793	4,392,158	689	156,962	2,695,220
1798	5,411,962	637	163,399	5,197.913
1803	6,040,067	614	180,950	2,344,647
1808	8,716,918	805	228,082	5,850,773
1814	8,200,506	685	212,776	6,284,353
1815	8,371,193	701	223.246	6,862,371
1816	7,428,617	680	219,042	4,559,665

The most remarkable fact in this table is the increased dimensions of the vessels; the average size of a West Indiaman, which, in 1783, was only 200 tons (registry) being now fully 320. The revenue arising from our West India imports is five millions annually, of which about three millions are from sugar; the rest chiefly from rum. The trade of these colonies has been exposed, particularly in the years 1806, 1807, 1808, and 1811, to the most distressing fluctuations. At the peace of 1814, Surinam was restored to Holland; but Demerara, Berbice, and Essequibo, remain to Britain, with certain provisions in favour of the Dutch proprietors of plantations. They are at liberty to send their produce to Holland, and to receive from that country the stores or other articles of supply necessary for their estates; but they are not allowed to import Dutch commodities for sale.

East Indies.—*Average of Exports from England to India (exclusive of China), on a series of Six Years, from* 1806 *to* 1811.

On account of the East India Company,	L.1,371,666
——— of private merchants trading to India,	453,666
——— of the captains and officers of the Company's shipping,	418,333
	L.2,243,665

This includes the specie exported, which, however, was to a small amount. The value of goods

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imported from India is increased by the freight, interest of money, expected profit, &c.; and, though very fluctuating, might be averaged previous to 1814 at L. 300,000 Sterling; and the seamen employed, at 6000. But since the trade has been laid open, speculations have been entered into from Liverpool, Bristol, and other ports, which have greatly altered the aspect of this branch of our commerce, and put all correct calculation out of the question. The exports are increased to a degree which cannot continue, as British merchandise has for some time sold in India considerably below prime cost.

Tonnage of Shipping cleared outward to the East Indies.

	1815.	1816.	1817.
From London,	78,431	87,866	85,172
—— Liverpool and other ports in Britain,	1,549	10,655	19,456
	79,980	98,521	104,628

(*Customhouse Return*, dated 1st May 1818.)

China.—This branch of trade remains in the exclusive possession of the East India Company. Our annual exports, from L. 1,000,000 to L. 1,200,000, are chiefly of broad cloth: our imports consist of tea in vast quantities; also of nankeens and raw silk. This trade employs nearly 20,000 tons of shipping, and 2000 seamen. (See the Article China in this *Supplement*, Vol. III. p. 108.)

X.—*Establishments for Religion and Education.*

Rank of the Clergy.

The Church of England has two archbishops and twenty-four bishops; all peers of the realm, and all indebted for their appointment to the Crown. The bishop of the Isle of Man is appointed by the Duke of Athol, and has no seat in the House of Lords. The province of York comprises four bishoprics, viz. Durham, Carlisle, Chester, and the Isle of Man; all the rest, to the number of twenty-one, are in the province of Canterbury. The clerical dignitary next to the bishop is the archdeacon, whose duty, though very different in different dioceses, may be termed that of a representative of the bishop in several of his less important functions. The number of archdeacons in England is about sixty. The name of Dean (*Decanus*) was probably derived from his originally superintending ten canons or prebendaries. Each bishop has a chapter or council appointed to assist him, and each chapter has a dean for president; but there are in the Church of England many deaneries of other descriptions. Rector is, in general, the title of a clergyman holding a living, of which the tithes are entire; vicar is understood of a living where the great tithes have passed into secular hands. The very general name of curate signifies sometimes (as *curé* in France) a clergyman in possession of a living, but more frequently one exercising the spiritual office in a parish under the rector or vicar. The latter are temporary curates, their appointment being a matter of arrangement with the rector or vicar; the former, more permanent, are called perpetual curates, and are appointed by the impropriator of the tithe in a parish which has neither rector nor vicar. The name of priest is, in general, confined to the clergy of the church of Rome; in the church of England, the corresponding term is a "Clerk in Orders." A parson (*parsona ecclesiæ*) denotes a clergyman in possession of a parochial church. Deacon is, in England, not a layman, as in Calvinist countries, but a clergyman of limited qualifications, entitled to preach, baptize, marry and bury, but not to give the sacrament. "Readers" are not regular clergymen, but laymen of good character, licensed by the bishop to read prayers in churches or chapels where there is no clergyman. See Adolphus *on the British Empire*, Vol. I.

A clerical education in England is of much less length than in Calvinist countries; in Scotland, Holland, Switzerland, or the North of Germany, after going through a course of classics and philosophy, a second course is required for theology solely, but in England the former is sufficient. The degree of bachelor of arts requires an examination and a university residence of three or four years; but to qualify for the acceptance of a curacy, a certificate of attending a single course of lectures in divinity is all that is necessary.

Livings.

The number of church livings in England and Wales is very great, being fully 10,500. From this multiplicity of benefices, and from the general smallness of the incomes, have arisen two irregularities,—pluralities and non-residence,—both forbidden by the ancient statutes of the church, but both long sanctioned by usage. Many clergymen hold livings without doing duty at any of them; others do duty in one or in two that are adjacent to each other, and have a curate for the more distant; while curates frequently do duty at two and sometimes at three distinct places of worship. To prevent, or at least to lessen the abuse of non-residence, an Act of Parliament was passed in 1813, directing that every non-resident incumbent should nominate a curate at a salary of not less than L. 80 a-year, unless the entire living should be less. The effect of this Act was to reduce the number of non-resident clergymen by 800 fully; they had previously been about 4700; but in 1815, the official return to Parliament of the incumbents in England and Wales was as follows:

Non-resident from the following causes:

Sinecures,	52
Vacancies,	164
Sequestrations,	40
Recent Institutions,	87
Dilapidated Churches,	32
Held by Bishops,	22
Law-suits, absence on the Continent, &c.	122
Livings from which no report,	279
	798
Incumbents non-resident from other causes,	3,856
Incumbents resident,	5,847
	10,501

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Tithes.

The rental of England and Wales was, by a late return, discriminated as follows in regard to tithes:

Tithe free *in toto*,	L. 7,904,379
Tithe free in part,	856,185
Free on payment of a *modus*,	498,823
Subject to tithe,	20,217,467
Total,	L. 29,476,854

A part, and by no means an inconsiderable one, of the tithes of England, is held by laymen; but as the church has other sources of income, its total revenue is computed at nearly L. 3,000,000; but the absorption of large sums by several of the prelates (as the Bishops of Durham, Winchester, and London), and the accumulation of the best livings among a few individuals of influence, reduce the annual average income of the curates, or most numerous class, to little more than L. 100 a-year.

Tithes necessarily fluctuate with the state of agriculture, and, during the distress of 1815, the deficiency in this respect became alarming. It was then that the clergy felt what they should have felt long before, that tithe was an unsuitable and impolitic source of revenue. Application was made to Parliament, and the subject was for some time under serious discussion; but the rise of corn, in 1816 and 1817, prevented any other measure than an Act founded on a Committee Report of 18th June 1816, authorizing the possessors of tithes (laymen as well as clergymen) to grant leases of them for a term not exceeding fourteen years.

A late return to Parliament (June 1817) specifies the incomes of those benefices where there is no parsonage-house, or at least none that forms a suitable residence.

	Livings.
From L. 10 to L. 100,	615
—— 100 to 150,	442
—— 150 and upwards,	793
	1850

Churches.

A prior and more comprehensive return had stated the number of churches and chapels for the established faith at 2533; and as these were inadequate (the members of the established church being about five millions, or half the population of England and Wales), an act was passed in 1818, and even pecuniary aid given by government, for the erection of a number of additional churches. The previous attempts to raise the requisite funds by the issue of briefs and voluntary subscriptions, had exhibited a miserable specimen of misapplied labour; the expences of the collection, and of the patent and stamps, absorbing more than half the money received from the subscribing parties.*

Clerical Terms.

A prebend is a provision in land or money given to a church in *præbendum*, that is, for the support of a clergyman whose title may be either prebendary or canon. Advowson (*advocatio*) is the right of presentation to a living, and was first vested in those laymen who were founders of, or benefactors to livings. A living is held *in commendam* when, to prevent its becoming void, it is committed (*commendatur*) until conveniently provided with a pastor. *Modus* (*modus decimandi*) is a composition for tithes; it may be either perpetual, or during the lives of the contracting parties. The lay impropriators of tithe, so frequent in England, date from the dissolution of monasteries in the reign of Henry VIII.; patrons were then allowed to retain the tithes and glebe in their own hands, without appointing a clergyman; in cases of such appointment, the clergyman was called *vicarius*, or representative of the patron.

Dissenters.

The dissenters in England are, first, the Presbyterians, who nearly coincide with the Church of England as to doctrine, but differ in church-government, allowing no hierarchy in individuals; next the Independents, who go farther, and disclaim hierarchy in synods and other collective assemblies; the well known sect of Quakers date from the middle of the seventeenth century; the more numerous Methodists from 1729. Of the Anabaptists, the chief characteristic is their not receiving baptism till they become adults. The Catholics in England are not numerous, but comprise a large proportion of wealthy families. The Test Act declares that no person can be legally elected to a public office unless he be a member of the Church of England; but an act of Parliament is annually passed to indemnify all persons who shall not have complied with the requisitions of the Test Act.

Education.

In regard to the mode of education in England, there is much both to commend and censure. Scotland has been for a century past in possession of a larger proportion of parish schools; but the utility of these is much lessened by an established routine of teaching Latin to almost all youths, whatever be their intended line of life. In England this absurdity is less prevalent, because most of the schools are private undertakings, the managers of which are necessarily guided by considerations of utility. The youth destined for a life of business are thus saved a serious waste of time; their education, if imperfect, is not supererogatory; but, on examining the higher seminaries of England, we find much ground for disappointment, and many marks of a blind adherence to ancient usage. Two universities are evidently inadequate to the education of the nobility, the gentry, and the clergy of so populous a country. Their course of study, also, is quite unsuitable to the future occupations of many of the students. They were originally designed for the education of churchmen; and, to this day, Latin and Greek, with the addition of mathematics at Cambridge, form the chief objects of instruction. In a country of which commerce forms the strength, there are no teachers of political economy. Under a government

* See *Return of Briefs delivered to Parliament*, 19th May 1819.

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which has so long borne the representative form, there are no classes for the study of modern history, or the principles of legislation. There are here hardly any of those public lectures, which, in the rest of Europe, constitute the grand characteristic of a university, and distinguish it from schools:—all, or nearly all, is done by private tuition. Each college has two, three, or more tutors (appointed from among the fellows), who receive in their rooms the students at stated hours, and read Greek or Latin with a class, which, in Oxford, rarely exceeds half a dozen at a time. Again, in point of constitution, while in other countries a university forms, in general, one large association, in England each college is a distinct body, having its head, its fellows, and its students, who, as far as education is concerned, have very little connection with the rest of the university. It is, doubtless, this insulation, both as to study and discipline, that has prevented the formation of public classes, and been the cause of the very uniform and limited course followed both at Oxford and Cambridge. In one point, however, these venerable seminaries redeem their faults, and assert the dignity of their character;—we mean in their public examinations. These, since the early part of the present century, have been put on an admirable footing, both at Oxford and Cambridge; distinguishing the relative degrees of proficiency with great accuracy, and converting into a full and impartial trial that which in other universities is almost always a mere form.

No country rivals England in the magnificence of her academical buildings. While in France, Germany, or Holland, a university possesses only a single pile of building, Oxford and Cambridge can boast for every college a large, commodious, and generally an elegant structure. The endowments appropriated to them are very various, both in their origin and destination, but they arise chiefly from land, and, having increased with the rise of rents, are in many cases very ample. The destination of these funds is regulated by the bequest of the donors, and the established usage of the colleges: part going to students, under the name of exhibitions or scholarships: part to the head and fellows; and a farther part, consisting in livings, which devolve in succession on the fellows, and lead to their removal from the university. The number of students has of late been considerably on the increase in both universities; but the public lists retaining the names of many who have long left college, the number actually engaged in a course of study does not exceed 2500, taking Oxford and Cambridge together. A hall is an inferior college; an academical establishment not incorporated or endowed, but possessed of exhibitions or other provisions for students. Oxford has nineteen colleges and five halls. Cambridge twelve colleges and four halls.

Boys in England are taught the classics, either in the lesser schools, established at every town of consequence throughout the kingdom, or at the great public schools. Of the latter, the principal are Eton, Westminster, Winchester, and Harrow; also the Charter-house, St Paul's, and Merchant Taylor's school. These seminaries, at present so expensive, and attended by youths of the first family, had their origin in a fund or provision, set apart for scholars of humbler birth. This has served as the basis of a stately superstructure, each school having attracted, by the advantage of situation, or the repute of the teachers, a much greater number of pupils in independent circumstances. But in each a proportion of the scholars are still on the foundation. At Eton there are 70 thus provided for; at Winchester the same number. *

Education of the Poor.

On the education of the poor, a great deal of useful information has been lately laid before the public, by the Reports of the Committee appointed to "inquire into the education of the lower orders;" at first in London, afterwards throughout England at large. The earliest of these Reports, dated in June 1816, contains various statements of the proportion of the poor, who are destitute of the means of instruction. In the neighbourhood of Covent Garden, the proportion was 679 uneducated out of 829. In Southwark, of 12,000 children between the age of five and fourteen, 6000 were unprovided with the means of instruction; but of all ignorant and abandoned districts, St Giles is beyond comparison the worst; containing more than half the Irish in the metropolis, whose children, in number about 3000, were not only uneducated, but trained, after the age of seven or eight, to habits of begging and thieving. Elementary schools were not absolutely wanting in London, nor was the price of admission unreasonable; but the want of decent clothing was, in very many cases, the cause of not sending the children thither. The whole number of children in the metropolis, unprovided with education, was computed at more than 100,000; and in all England, the number is certainly not overrated at 500,000.

The efforts of the *National Society*, as Dr Bell's adherents term their establishment, make a very conspicuous figure in the evidence annexed to these *Reports*. The amount subscribed from 1811, the time of its formation, to last year, was (*Second Report*, p. 10) about L.40,000; the chief part from occasional donations, the annual subscriptions amounting only to L.1500. This society, though it has established only one great school, that of Baldwin's Gardens, in Gray's Inn Lane, has contributed to the erection or enlargement of more than 200 schools, by pecuniary grants, varying from L.15 to L.100, and amounting, in particular cases, to L.200, and even L.300. Above 500 teachers, male and female, have been trained on Dr Bell's plan, and the number of children now receiving education on this system is between 150,000 and 200,000, distributed over more than 1000 schools in all parts of the kingdom. Of these, the greater part have adopted Dr Bell's plan, without receiving any other aid than a supply of elementary books. The conditions required by the Society in return for

* *Reports of the Education Committee*, 1817 *and* 1818.

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their aid, were, that the liturgy and catechism of the Church of England should be followed, and that no religious tracts, except those sanctioned by the *Society for Promoting Christian Knowledge,* should be admitted into the schools. The Society, however, is by no means illiberal, extending its instruction to children of all denominations, even Jews (*Report First*, p. 32), and allowing dissenting pupils to attend divine service in the place pointed out by their parents. In regard to expence, though not so small as asserted in some extreme statements which have gone abroad, nothing can be more gratifying than to find that, even in the opinion of the witness disposed to rate it at the highest, it does not exceed (*Evidence*, p. 268) 12s. *per* head *per annum*. One master, with the aid of monitors, can superintend 500 scholars.

The British and Foreign School Society, for that is the name adopted by the supporters of the Lancasterian plan since their separation from its founder, without possessing such extensive support as the *National Society*, have been extremely liberal and active; having collected above L.20,000 previous to 1816, and having expended considerably more; the trustees advancing the balance from their own property. Among other supporters, this Society reckons one who conceals his name from all but the treasurer, and who has already come to its aid with the large sum of L.3000! The original and central school of this Society is in the Borough Road, Surrey. The number of schools throughout the kingdom for boys and girls is supposed to exceed 400, having, on an average, from 150 to 200 pupils. The expence of the Society in aiding schools, and still more in training male and female teachers, is between L.2000 and L.3000 a-year.

Until these benevolent establishments were disseminated, the principal means of instruction for numbers of the poor were in the *Sunday Schools*; an institution highly advantageous, in preventing an improper observance of Sunday, but necessarily of very slow effect in the business of teaching. The number of Sunday scholars in the metropolis is computed (*First Report*, p. 76) at 40,000; but the time required there by a child to learn to read extends to two, two and a half, and even to three years. The *Society for Promoting Christian Knowledge* is of old date, having been founded in 1698. Its object is to assist parish schools which belong to or are not adverse to the Church of England, with books at a very reduced price, about half the prime cost. The funds arise partly from money in the stocks, partly from voluntary contribution. The annual income and expenditure exceed L.40,000.

The Education Committee brought its labours to a close in a *Third Report*, dated June 1818. Their concluding observations were, That the discussion excited by the inquiry had greatly improved the administration of institutions for the education of the poor; but that much remained to be done; the efforts of private benevolence being almost entirely confined to towns, and the aid of government being wanted in the thinly peopled districts, to the extent, at least, of the purchase or erection of a school-house, leaving the annual expence to be defrayed by private subscriptions. The Committee recommend farther, a connection between such schools and the Established Church, although, in England, this is a matter of greater difficulty than in Scotland, where, in point of doctrine, the dissenters differ very little from the Establishment. In regard to the anxiety of the poor for the education of their children, there is, say the Committee, the most unquestionable evidence that it is not only unabated, but daily increasing.

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XI.—*Establishments for purposes of Charity.—Poor-Rates.*

The public charities of England are very numerous; the bequests of benevolent founders in this country exceeding those of the zealous Catholics of France or Spain, as well as those of the once affluent Protestants of Holland. Our limits admit of the notice of only a few of the foundations in the metropolis and its neighbourhood.

Among the principal *Hospitals* are,

Bethlem Hospital.
St Luke's, Old Street.
St Bartholomew's, West Smithfield.
Guy's, in Southwark.
The Lock Hospital, Hyde-Park-Corner.
The London Hospital, Whitechapel Road.
The Magdalen Hospital, St George's Road.
The Middlesex Hospital, Berner's Street.
The Foundling Hospital.

Among the *Dispensaries* and medical charities are,

The General Dispensary, Aldersgate Street
City Dispensary in the Poultry.
Finsbury Dispensary.
Various Vaccine Dispensaries.
The Fever Hospital, instituted in 1801.

A *College*, in the sense of a charity, is an alms-house on an enlarged scale, under the direction of a master and other incorporate officers. There are only three in the neighbourhood of London, viz. Bromley, Morden, and Dulwich Colleges.

Alms-Houses.—These are very numerous, viz. the Haberdashers', Mercers', Skinners', East India Company's, &c.

School Charities.—These also are very numerous. Among the most remarkable are,

Christ's Hospital, or the Blue Coat School.
Marine Society.
School for the Indigent Blind.
Deaf and Dumb Asylum.
Debtors' Children.
Ladies' Charity School.
Masonic Charity.
Raines's Charities.

Miscellaneous Charities.—Under this head are comprised several extensive and well known associations.

The African Institution.
The British and Foreign Bible Society.
Society for Bettering the Condition of the Poor.
Society for Promoting Christian Knowledge.
The Missionary Society.
The Literary Fund.

Poor Rates.

We must next advert to a much more serious subject,—to the consideration of a tax, which, of all the burdens of England, is perhaps the most oppressive,

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we mean that levied for the *Poor*. The discussion, in a politico-economical sense, must be deferred till we treat of the POOR-LAWS. At present we can exhibit only the principal returns and calculations, none of which, that are at all complete or accurate, go farther back than the middle of the last century.

The following table shows the expenditure on the Poor of England and Wales, making the year close at Easter, and adding the corresponding average price of the bushel of wheat.

			Wheat.
1748, 1749, 1750,	average	L. 692,000	4s. 5d.
1776,	. .	1,566,000	6s. 9d.
1783, 1784, 1785,	average	2,010,000	7s. 7d.
1803,	. .	4,268,000	8s. 1d.
1813, 1814, 1815,	average	6,147,000	12s. 8d.

The amount of expenditure in each tenth year, calculated from the above, together with the price of wheat, will stand thus:

		Wheat.
1750, . .	L. 713,000	4s. 2d.
1760, . .	965,000	4s. 10d.
1770, . .	1,306,000	6s. 5d.
1780, . .	1,774,000	5s. 11d.
1790, . .	2,567,000	6s. 4d.
1800, . .	3,861,000	10s. 2d.
1810, . .	5,407,000	12s. 4d.

The sums of expenditure are taken from the *Second Report on the Poor-Laws* (March 1818), and the price of wheat is added, because the well known rule of English parishes, in affording relief to the poor, is to proceed on a conjunct calculation of the price of bread and the number of children in a family.

The following table shows the proportion of the wages of the country labourer to the price of corn. (Barton *on the Labouring Classes*, published in 1817.)

Periods.	Weekly Pay.	Wheat *per* Quarter.	Wages in Pints of Wheat.
1742 to 1752,	6s. 0d.	30s. 0d.	102
1761 to 1770,	7s. 6d.	42s. 6d.	90
1780 to 1790,	8s. 0d.	51s. 2d.	80
1795 to 1799,	9s. 0d.	70s. 8d.	65
1800 to 1808,	11s. 0d.	86s. 8d.	60

These statements exhibit in the enhancement of wheat one very considerable cause of augmentation of the poor's-rate.

We now come to returns of later date; the result of the researches of the *Committee on the Poor-laws*, whose first and most comprehensive Report was made to Parliament in July 1817.

Return of Poor-Rates from London, Westminster, and Southwark, being from the Parishes within the Bills of Mortality, delivered to Parliament 21st February 1817.

	Year ending Easter 1813.	Easter 1814.	25th March 1815.
	L.	L.	L.
Total raised in the metropolis by poor's-rate, and smaller rates, such as church-rate, highway-rate, &c.	446,542	501,952	489,321
Charitable donations for parish schools and other purposes, .	18,983	19,620	20,160
Expenditure.			
Relief and maintenance of the poor, ...	L. 370,518	401,954	380,281
Lawsuits, removals, expences of overseers, and other officers, .	15,324	17,416	17,433
Families of militia-men, ...	12,916	10,837	6,613
Church-rate, highway-rate, county-rate, &c. . . .	98,903	113,574	103,807
Total, . .	L. 497,661	543,781	508,134
Number of Poor relieved permanently.			
In workhouses, ...	13,389	13,373	12,341
Out of workhouses (without reckoning the children), . .	12,654	13,762	13,341
Parishioners relieved occasionally, either in or out of workhouses, .	40,993	69,332	70,322
	67,036	96,467	96,004

Returns applicable to the Kingdom at large.

	Year ending Easter 1813.	Easter 1814.	25th March 1815.
	L.	L.	L.
Total money raised by poor's-rate; and, in a smaller degree, by church-rate, highway-rate, county-rate, &c. in England and Wales, .	8,651,438	8,392,728	7,460,855
To these sums are to be added charitable donations, whether arising from land or money, managed by the clergy, church-wardens, or overseers; Annual average, ...	238,310	238,310	238,310

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Expenditure.

	Year ending Easter 1813.	Easter 1814.	25th March 1815.
	L.	L.	L.
For the maintenance and relief of the poor,	6,679,658	6,297,331	5,421,168
Lawsuits, removal of paupers, and expences of overseers or other officers,	325,107	332,966	324,665
Families of militia-men and other militia charges,	246,202	188,576	105,394
Church-rate, county-rate, highway-rate, &c.	1,614,871	1,692,990	1,657,627
	L. 8,865,838	8,511,863	7,508,854

Number of Persons relieved by this Expenditure.

Poor permanently relieved in workhouses,	97,223	94,085	88,115
Do. do. out of workhouses (without reckoning children),	434,441	430,140	406,887
Parishioners relieved occasionally,	440,249	429,770	400,971
Total of paupers relieved,	971,913	953,995	895,973

The property liable to poor's-rate consists of the land and houses of England, the annual rent of which, under the latest estimate, is	L. 51,898,424
Deducting for various allowances and abatements, the fractional sum	1,898,424
Remains,	L. 50,000,000

The average poor-rate on which, for the three years in question, is 3s. 4d. *per* pound. In general, the computation is made differently, and at so many shillings not *in* but *on* the pound,—thus 20s. on the pound would be half the actual rent. Sussex, the county the most burdened with poor-rates, paid 7s. 8d. *on* the pound in 1813.

The number of persons receiving parish relief in England is beyond example in any country or any age, being fully one person in eleven, if we compute by the above enumeration; and many more (not less than one in eight), if we comprise the children of the 400,000 or 500,000 persons who receive permanent relief at their homes. The workhouse plan is adopted in the case of nearly 100,000 individuals. Its extension was in a great measure owing to an act passed in 1782, commonly called Mr Gilbert's Act, which, to obtain the advantages arising from a collective assemblage of the poor, from a joint management of disbursement and a considerable division of labour, empowered the magistrates to consider any large workhouse as a common receptacle for the poor throughout a diameter of 20 miles. As yet this plan has by no means been successful. Proper care has seldom been taken to separate the inmates of the workhouses according to their age or their habits; nor has the division of employment been carried to the necessary length. The four shillings a week, which each pauper generally costs in a workhouse, is much more than would have been requisite at their own habitations.

Scotland was originally subjected to a similar system for the poor, but fortunately escaped its perversion, from the execution of the law being vested, not in temporary officers, such as church-wardens and overseers, but in the landholders, ministers, and elders, whose personal acquaintance with the poor enabled them to act with discrimination. It would be no small improvement in England to appoint, as overseer, a permanent officer with a salary, to act, if necessary, for more than one parish, a practice already adopted in some cases with success. The landed interest complain that the burden of the poor's-rate falls exclusively on them and the owners of houses. But there are strong objections to imposing any part of this burden on the income of the stockholders or the profit of traders. (*Report on the Poor Laws*, 4th July 1817, p. 6.) There would be no check to a perpetually increasing disbursement were the burden to be rendered national instead of parochial. Nor is it true that the trading and manufacturing districts have increased their paupers in a greater proportion than the agricultural. In Bedfordshire and Herefordshire, the two counties which employ the largest proportion of their inhabitants in agriculture, the same progressive augmentation of assessment has taken place. (See *Report on the Poor Laws*, 1817, p. 8.)

	Expended on Paupers in 1776.	Average Expenditure of 1783, 1784-5.	In 1803.	In 1815.
Herefordshire,	10,593	16,728	48,067	59,256
Bedfordshire,	16,663	20,977	38,070	50,371

The consideration of most importance, as connected with the landed interest, is the reciprocal effect of the poor and the corn-laws; if the latter afford the landholders an indemnity for the extra burden of the former, the public may fairly claim a proportional reduction of the importation limit of corn in return for such alleviation as may be made in the pressure of the poor-rates on the land. This idea, at which our limits permit us only to hint, might, in our opinion, be made the basis of the most beneficial regulations. A great proportion of the present poor's-rate has arisen from the voluntary conduct of the more affluent classes, who, during the war, preferred paying an extra charge to raising the wages of country labour. This was shown by the remarkable fact of such labour being considerably cheaper in England than in Scotland. An effectual reduction, therefore, can take place only in two ways; either by raising wages as parish relief is withdrawn, or by approximating the personal expences of our poor to that of

Establishments for the Purposes of War.

the poor of the rest of Europe, by a progressive abrogation of the corn-laws.

Friendly Societies.—These associations are spoken of with much commendation in the *Reports of the Committee on the Poor Laws.* We extract the number of members.

	In 1813.	1814.	1815.
In London, Westminster, and Southwark, .	42,365	43,080	52,312
In England and Wales,	821,310	838,728	925,439

XII.—*Establishments for the Purposes of War.*

The establishments both for the Navy and Army have, in the present age, been carried to an extent of which no country has exhibited an example. Greater efforts, perhaps, have been made on sudden emergencies, both in ancient and modern times; but neither Prussia, the most military state on the Continent, nor France in the reign of Buonaparte, could stand a comparison during last war with England in the proportion borne by her armed force to the population at large. The difficulty lay, not in levying every tenth, or even every eighth man in a courageous population, but in finding, from the public credit and the productive industry of the rest of the community, the means of supporting so vast a number "in arms and idleness" during a succession of years.

Annual Expenditure for our Navy, Army, and Ordnance during last War, from the Returns to Parliament.

Years.	Navy.	Army.	Ordnance.
1803	7,979,878	11,299,406	1,827,049
1804	11,759,351	15,744,694	3,550,141
1805	14,466,998	17,019,728	4,732,286
1806	16,084,027	15,111,490	4,511,064
1807	16,775,761	15,208,550	4,190,748
1808	17,467,892	17,201,061	5,108,900
1809	19,236,036	18,463,094	4,374,184
1810	20,058,412	18,536,299	4,652,331
1811	19,540,678	23,869,359	4,557,509
1812	20,500,339	24,987,362	4,252,409
1813	21,996,624	29,469,520	3,404,527
1814	21,961,566	33,795,556	4,480,729
1815	16,373,870	23,172,137	3,736,425
Total during 12 years of war,	L.207,827,562	240,706,119	49,641,877

The navy expenditure increased very gradually; that of the army took a sudden rise in 1812 and 1813, owing, in part, to our increased scale of exertion in Spain, but more to the unfortunate fall of the exchanges, which, in these years, were nearly 30 *per cent.* against us. These returns refer, of course, not to England alone, but to the United Kingdom at large. The numbers maintained in the latter years were, in the navy, 140,000 seamen and marines; in the army about 300,000; viz. in regulars and in foreign corps, exclusive of our troops in India, 207,000; in regular militia, 93,000; the whole effective, and without reckoning a very numerous force of local militia, occasionally embodied. In 1814, a great reduction took place, particularly in the navy. In 1815, the alarm caused by Buonaparte's return suspended for a time the reduction of the army, but, in 1816, there were nearly 37,000 discharges, exclusive of 10,000 deaths and desertions. Still we had, in 1817, a force abroad and at home, of nearly 20,000 cavalry, 6000 foot guards, and 115,000 infantry. The expence of nearly 50,000 of these troops was defrayed by France and the East India Company; for the remainder the following sums were voted by Parliament:

Abstract of the Army Estimates for 1817, exclusive of the Extraordinaries of the Army.

	Annual Charge.
Land forces (exclusive of those serving in France and India), 92,282 officers and men, . .	L.3,351,377
Staff officers, . . .	146,816
Public departments, . .	163,104
Medicines, &c. . . .	26,446
Volunteer Cavalry, . . .	106,665
Additional pay to general officers who are not Colonels of regiments,	179,045
Full pay of those officers who have retired on that condition,	132,536
Total half-pay and allowances to other officers, . . .	813,012
Pensions to subalterns and privates,	1,009,530
Widows' pensions, . .	98,984
Compassionate list, and pensions for wounds, ...	163,502
Garrison charges at home and abroad,	34,078
Military college (Sandhurst), .	28,155
Military asylum (Chelsea) for soldiers' children, . . .	34,415
Superannuation allowances, adjutants of Local Militia, and Exchequer fees,	80,067
	L.6,367,732

Since 1817, a farther and very large reduction has taken place, particularly in the course of 1818 and the present year. The peace establishment, exclusive of the troops of India, is at present fixed at 8954 cavalry, 5760 foot guards, 55,090 infantry; making a total of 69,794. This is considerably beyond the peace establishment of 1792; and in consequence of the large sums issued for the half-pay of officers and the pensions of privates, the expenditure is still very great, being computed by the Finance Committee (*Second Report in* 1819) at L.6,380,000 annually; to which is to be added a charge, varying from year to year, but hitherto very heavy, under the head of "Army Extraordinaries." The infantry now consists of only 93 regiments; the light dragoons of 19. During the war, there were 33 regiments of light dragoons, and 135 regiments of foot, many of them of two battalions. An extra proportion of our military are at present stationed in Ireland, to prevent illicit distillation and other frauds on the revenue. In India, our force consists of about 20,000 King's troops and 8000 Company's, all Europeans, and exclusive of 150,000 natives; the whole are in the pay of the East India Company.

Navy.

The progressive increase of our naval force in-

Establishments for the Purposes of War.

spires no dread among the friends of constitutional liberty. In the war that followed the Revolution of 1688, our navy consisted of about 30,000 seamen; that of Louis XIV. was not inferior until the battle of La Hogue in 1692. In the war of 1740, our force was carried to 40,000, and eventually to nearly 50,000 seamen. In the succeeding war, the vote in the year 1760 was for 70,000, a number till then unprecedented. Last war, when we had 140,000 seamen in service, and above 30,000 marines, there were in commission nearly 160 sail of the line and 150 frigates. At present, the reduced state of the naval power of other countries has led to our peace establishment being brought so low as 13,000 seamen and 6000 marines. There are thus only five sail of the line in full equipment; the guard-ships have only a fifth of the war complement, and the other vessels in commission are chiefly employed in the prevention of smuggling. Still the annual vote for this department is large, in consequence of the great exertions made in peace for rebuilding our shipping and improving our dock-yards. In 1817, the navy estimates were,

19,000 seamen and marines; wages, victualling, &c. . .	L.1,672,000
Half-pay and pensions, .	1,230,000
Building and repairs, . .	1,391,645
Ordinary of navy and repairs, .	1,243,457
Provisions for ships abroad, . .	300,000
Transport service, . . .	182,176
Sick and wounded, . . .	79,350
	L.6,098,628

In 1818, the navy estimates amounted to L.6,457,000; in 1819, to L.6,436,000. The number of seamen receiving pensions without living at Greenwich hospital exceeds 30,000, of whom nearly the half are capable of active service.

List of Navy Officers on 30th September 1818.

	Total Number.	Employed.
Admirals, . .	183	13
Post Captains, .	852	62
Commanders, .	789	56
Lieutenants, .	3923	404
Masters, .	643	142
Pursers, . .	815	130
Physicians, . .	16	
Surgeons, . .	934	113
Assistant-surgeons,	367	161
Total,	8522	1081

Of the fortified places of England, the principal are the Dock-yards. Chatham contains an arsenal on a large scale; our dismantled vessels lie there in great numbers, and in the naval warehouses the stores are arranged in the highest order. Sheerness has of late years been greatly improved; a change which required all the resources of ingenuity and finance; the ground on which the town stands having been progressively formed by alluvial deposits from the Medway, and wanting, in a great measure, the consistency of primitive soil. Portsmouth has the largest victualling establishment after Deptford, and the greatest store of artillery after Woolwich; in point of edifices and works generally, it is our first naval station; it is also the usual port for the equipment of an armament. Plymouth possesses a road-stead of great depth and extent; and the anchorage has been lately much improved by the erection of the BREAKWATER, a great national work fully described in this *Supplement*, under that head. Milfordhaven is a still more capacious road-stead than Plymouth, and would form a most valuable depôt were its position less remote; as yet it has been used only for shipbuilding.

Various particulars relative to the government and economy of both army and navy will be found under the Articles ACADEMIES,—MILITARY; BARRACKS; DOCK-YARDS; GREENWICH HOSPITAL; NAVY.

Revenue and Expenditure.

XIII.—*Revenue and Expenditure.*

The revenue of England, in the reign of Queen Elizabeth, hardly exceeded L. 600,000 a year; under Charles I. it was about L. 800,000; under Charles II. from L. 1,200,000 to L. 1,500,000. James II. raised it to L. 2,000,000, a sum, however, which fell considerably short of the contemporary revenue of Holland, and was not above a third of that of France. After the Revolution, the necessity of great military efforts led to the imposition of the land-tax, and the average revenue under King William was about L.4,000,000; under Queen Anne, the same motives for exertion produced an augmentation to L.5,000,000, and eventually to L.6,000,000. In the pacific reign of George I. the revenue rather exceeded L.7,000,000, and a farther but gradual augmentation took place towards the middle of the century.

Increase of the Public Revenue during the reign of George III.

1761, . .	L. 8,800,000
1764, . .	9,250,000
1767, . .	9,200,000
1770, . .	9,510,000
1773, . .	10,066,661
1776, . .	10,265,405
1779, . .	11,192,141
1782, . .	12,593,297
1785, . .	14,871,520
1788, . .	15,572,971
1791, . .	16,631,000
1792, . .	19,382,435
1793, . .	17,674,395
1794, . .	17,440,809
1795, . .	17,374,890
1796, . .	18,243,876
1797, .	18,668,925
1798, . .	20,518,780
1799, . .	23,607,945
1800, . .	29,604,008
1801, . .	28,085,829
1802, . .	28,221,183

The following table contains a comprehensive view of our taxes and loans since that period.

Revenue and Expenditure.

Public Income of Great Britain in each Year, from 1803 to 1817 inclusive.

	1803.	1804.	1805.	1806.	1807.
Customs,	L. 8,024,681	9,362,127	10,174,213	10,819,637	10,592,606
Excise,	18,771,989	21,477,403	23,193,515	24,080,663	24,680,640
Stamps,	3,326,753	3,518,545	4,062.284	4,278,538	4,401,660
Land Tax,	1,307,941	1,467,283	1,536,481	1,451,772	1,432,789
Assessed Taxes,	4,468,131	4,429,106	4,508,752	4,821,206	5,451,660
Post-Office,	1,256,801	1,277,391	1,424,994	1,490,968	1,472,870
Crown-lands, tax on pensions, &c.	142,441	162,524	212.159	198,912	199,993
Property-tax,	378,326	3,665.063	4,546,883	6,162,558	10,158,007
Total raised by Taxes,	L. 37,677,063	45,359,442	49,659,281	53,304,254	58,390,225
Lottery, net profit,	351,507	432,645	378,648	496.010	774,694
Loans, actual receipts,	11,950,000	13,209,251	25,130,404	19,699,263	15,257,211
Increase of outstanding Exchequer Bills,	2,611,600	6,185,900	1,926,900	27,100	7,735,400
Unclaimed dividends and various receipts,	289,824	276,425	495,530	263,782	121,952
Exchequer bills funded,	......	......	......	......	......
Total money raised,	L. 52,879,994	65,463,763	77,590,763	73,790,409	82,279,482
Deduct loan and lottery for Ireland,	2,117,444	3,733,291	3,211,062	1,768,000	3,681,251
And charges of the collection of revenue,	1,955,368	2,135,176	2,257,185	2,375,828	2,699,048
Total applicable to the service of Great Britain,	L. 48,807,182	59,595,296	72,122,516	69,646,581	75,899,183

	1808.	1809.	1810.	1811.	1812.
Customs,	L. 10,600,776	12,016,451	12,438,243	11,038,148	11,895,195
Excise,	25,592,813	23,470,546	25,796,008	26,078,297	23,531,736
Stamps,	4,680,071	5,305,782	5,505,632	5,236,020	5,273,907
Land Tax,	1,582,732	1,511,550	1,418,337	1.333,432	1,368,128
Assessed Taxes,	5,915,623	6,840,551	6,233,161	6,006.865	6,091,948
Post-Office,	1,476,558	1,558,409	1,709,065	1,685,936	1,796,586
Crown-lands, tax on pensions, &c.	276,073	288,202	76,916	150,276	72,123
Property-tax,	11,413,561	12,413,803	13,504,004	13,234,896	13,140,231
Total raised by Taxes,	L. 61,538,207	63,405,294	66,681.366	64,763,870	63,169,854
Lottery, net profit,	457,620	454,819	469,616	302,387	373,396
Loans, actual receipts,	10,102,620	14,675,668	13,242,356	16,636,375	29,268,586
Increase of outstanding Exchequer Bills,	5,150,300	——	——	3,205,500	3,914,600
Unclaimed dividends and various receipts,	766,225	242,104	405,816	253,867	1,263,402
Exchequer Bills funded,	4,000,000	7,932,100	8,311,000	7,018,700	5,431,700
Total money raised,	L. 82,014,972	86,709,985	89,110,154	92,180,699	103,421,538
Deduct loan and lottery for Ireland,	2,589,166	2,921,527	5,294,416	4,432,292	2,888,500
And charges of the collection of revenue,	2,816,568	2,886,201	2,934,876	3,096,581	3,273,242
Total applicable to the service of Gr. Britain,	L. 760,68,238	80,902,257	80,880,862	84,651,826	97,25,7969

	1813.	1814.	1815.	1816.	1817.
Customs,	L. 11,985,900	12,835,834	11,360,190	9,177,591	12,713,588
Excise,	25,272,414	26,471,224	27,206,806	23,595,268	22,829,364
Stamps,	5,473,409	5,778,579	6,139,585	6,184,289	7,101,767
Land Tax,	1,303,399	1,285,982	1,084,251	1,127,929	1,163,320
Assessed Taxes,	6,570,461	6,725,790	6,524,766	6,129,978	6,500,000
Post-Office,	1,912,114	2,051,929	1,755,898	1,659,855	1,644,925
Crown-lands, tax on pensions, &c.	87,702	41,322	244,024	249,629	242,251
Property-tax,	14,320,436	14,493,532	14,978,557	12,039,157	2,519,410
Total raised by Taxes, *	L. 66,925,835	69,684,192	69,294,077	60,163,696	54,714,625
Lottery, net profit,	278,666	356,104	304,652	234,681	196,689
Loans, actual receipts,	35,050,574	36,078,047	39,421,959	8,939,800	——
Increase of outstanding Exchequer Bills,	2,110,400	10,424,900	——	3,208,400	14,000,000
Unclaimed dividends and various receipts,	831,482	300,646	260,173	438,478	925,575
Exchequer Bills funded,	15,755,700	——	——	——	——
Total money raised,	L. 120,952,657	116,843,889	109,280,861	72,985,055	69,836,889 (Ireland is included in the above.)
Deduct loan and lottery for Ireland,	744,140	5,953,985			
And charges of the collection of revenue,	3,504,938	3,573,261	No deduction, the above being the net sums collected.		
Total applicable to the service of Gr. Britain,	L. 116,703,579	107,316,643			

* The diminution in 1816 was caused by a partial reduction of the *war-taxes*; and the farther diminution in 1817 by the repeal of the *property-tax*.

Revenue and Expenditure.

Public Expenditure of Great Britain in each Year, from 1803 to 1817, both inclusive.

	1803.	1804.	1805.	1806.	1807.
Interest on debt, funded and unfunded,	L. 17,861,341	18,698,307	20,022,068	20,524,718	21,021,772
Management of ditto,	235,891	253,375	256,483	275,108	278,594
Sinking fund,	6,287,941	6,521,394	7,181,482	7,829,589	8,908,673
Civil list,	898,000	1,519,842	958,000	958,000	958,000
Various pensions and allowances,	408,889	336,007	381,263	479,976	392,324
Civil government of Scotland,	79,502	79,705	86,918	83,750	85,359
Bounties,	308,335	359,980	401,613	345,119	536,948
Courts of justice, militia, &c.	172,301	570,479	512,700	393,752	413,711
Navy, ordnance, and army,	21,106,334	31,054,186	36,219,012	35,706,582	36,175,060
Subsidies,	——	——	——	——	180,000
East India Company,	1,000,000	——	1,000,000	1,000,000	——
Miscellaneous services,	1,800,500	1,161,156	2,115,334	1,706,676	1,195,448
Total,	L. 50,159,034	160,554,43	69,084,873	69,303,270	70,145,889

	1808.	1809.	1810.	1811.	1812.
Interest on debt, funded and unfunded,	L. 20,986,595	21,356,248	21,785,732	21,806,900	23,051,918
Management of ditto,	195,972	204,645	203,044	211,177	214,481
Sinking fund,	9,523,339	10,155,105	10,783,018	11,511,486	12,433,345
Civil list,	958,000	958,000	958,000	958,000	1,019,538
Various pensions and allowances,	398,921	391,093	395,114	394,321	532,693
Civil government of Scotland,	85,470	90,954	118,186	109,693	112,748
Bounties,	473,458	604,061	583,281	399,822	392,915
Courts of justice, militia, &c.	554,689	460,349	406,526	430,997	432,115
Navy, ordnance, and army,	39,777,854	42,073,316	43,247,044	47,967,547	49,740,111
Subsidies,	1,400,000	2,050,000	2,060,192	2,977,747	5,315,528
East India Company,	1,500,000	——	1,000,000	500,000	2,500,000
Miscellaneous services,	1,461,359	1,441,722	1,236,451	1,348,446	2,993,243
Total,	L. 77,315,657	79,785,493	82,776,588	88,616,136	98,738,635

	1813.	1814.	1815.	1816.	1817.
Interest on debt, funded and unfunded,	L. 24,224,349	26,409,083	28,357,733	27,614,939	31,583,058
Management of ditto,	220,153	221,589	284,673	278,189	275,735
Sinking fund,	14,145,242	12,710,706	12,798,226	13,422,749	14,596,685
Civil list,	1,028,000	1,246,857	1,028,000	1,028,000	1,191,169
Various pensions and allowances,	428,067	463,299	436,989	611,413	1,032,952
Civil government of Scotland,	113,176	114,032	126,614	128,515	130,646
Bounties,	228,741	244,308	247,903	247,133	330,046
Courts of justice, militia, &c.	594,812	545,510	206,633	196,779	201,900
Navy, ordnance, and army,	54,870,672	60,237,851	43,282,432	25,225,620	17,523,328
Subsidies,	11,294,416	10,024,623	11,035,248	1,731,140	7,502
East India Company,	2,000,000	——	——	——	——
Miscellaneous services,	1,717,132	1,856,236	3,187,477	3,776,163	2,369,800
Total,	L. 110,864,760	114,074,094	100,991,928	74,260,640	69,242,821

These tabular statements form a history of our finances since 1803, and are so comprehensive as to render unnecessary any other observation, than that there is seldom an equality between the amount received and expended by government, because the accounts of the one year are necessarily blended with those of the succeeding. The deficiency of revenue in 1817 was met by a large issue of Exchequer bills. In 1818, the revenue improved by nearly L.2,000,000; but there still remained a deficiency of L.13,000,000, which necessitated a recourse in that year to temporary expedients; and, in the present year (1819), to a loan and a vote of large additional taxes.

National Debt.

Our national debt originated in the great struggle made under King William, against the aggrandizement of France. It amounted,

At the peace of Ryswick, in 1697, to	L.21,516,000
At the peace of Utrecht, in 1714,	53,681,000
At the peace of Aix la Chapelle, in 1748,	78,293,000
At the peace of Paris, in 1763,	133,960,000
At the peace of Versailles, in 1783,	238,231,000

Sinking Fund.

So early as 1716 a Sinking Fund was commenced and persevered in with considerable firmness by Sir R. Walpole. The supplies for it were derived partly from surplus taxes, partly from a reduction of the

Revenue and Expenditure.

interest of the existing debt. In 1733, an extraordinary demand for money caused a trespass on the inviolability of this fund, and the principle once infringed, there was no limit to subsequent encroachments. The sinking fund continued to bear the name, but it had not, so lately as 1772, discharged 15 millions of the public debt. At last, in 1786, Mr Pitt revived this measure, following in substance the plan of Sir R. Walpole, but investing the new reserve with additional precautions, by nominating a special Board of Commissioners, and rendering them independent not merely of the treasury, but, in some respects, of Parliament. It was then that the public first became familiar with the term *Consolidated Fund*, which means nothing more than the aggregate of the permanent taxes; from which aggregate government pledged itself to pay a million yearly to the commissioners for the redemption of the public debt. This fund of a million was to be farther augmented by public annuities as they expired, and by the interest of the redeemed debt, which was to be paid as formerly by government at the bank, but into the hands of the sinking fund commissioners. The measure, now brought into operation, paid off the following sums:

In 1787,	. .	L. 662,750 stock.
1788,	. .	1,456,900
In 1789,	. .	L. 1,506,350 stock.
1790,	. .	1,558,850
1791,	. .	1,587,500
1792,	. .	1,507,100

The extinction of these sums, so inconsiderable at present in our eyes, had a powerful effect in reviving public confidence and raising the price of stock. The only dread was lest a renewal of war should necessitate new loans of far greater amount than these annual liquidations. To counteract this impression Mr Pitt added, in 1792, an annual L. 200,000 to the previous million, and (what was of much more importance) obtained an act of Parliament, declaring that all future loans should carry in themselves the means of their gradual extinction, by including, for the sinking fund, a surplus of one *per cent.* over and above the money required for the current service. This provision, and the great commercial prosperity of the year 1792, produced a rise of the three *per cents.* to the extraordinary price of 98; but this flattering prospect was soon overcast by the wars of the French revolution. After these wars burst out, our financial operations assumed a very different aspect; for though our debt sustained a periodical reduction from the sinking fund, it was augmented in a much greater proportion by the new loans.

Table of the National Debt, and of the Operation of the Sinking Fund, the whole stated not in Money, but in Stock.

Years.	Total of Debt.	Paid off each Year by the Sinking Fund.	New Debt Contracted.	Debt remaining Unredeemed.
1793	L.238,231,248	L. 1,962,650	L. ————	L.227,989,148
1794	244,481,248	2,174,405	6,250,000	232,064,743
1795	260,157,773	2,804,945	15,676,525	244,936,323
1796	311,863,471	3,083,455	51,705,698	293,558,566
1797	368,809,040	4,390,670	56,945,569	346,113,465
1798	394,159,040	6,695,585	25,350,000	364,767,880
1799	429,783,290	7,779,807	35,624,250	392,612,323
1800	451,658,290	20,211,571	21,875,000	394,275,752
1801	480,703,290	10,281,776	29,045,000	413,038,977
1802	536,657,603	9,925,739	55,954,313	459,067,551
1803	567,008,978	8,846,450	30,351,375	480,572,476
1804	583,008,978	12,409,854	16,000,000	484,162,622
1805	603,925,792	11,951,711	20,916,814	493,127,726
1806	640,752,103	12,673,475	36,826,311	517,280,561
1807	670,632,103	14,085,017	29,880,000	533,075,543
1808	689,005,303	14,672,717	18,373,200	536,776,026
1809	702,698,556	14,728,227	13,693,253	535,741,052
1810	723,975,678	15,061,321	21,278,122	541,957,854
1811	743,787,785	16,106,263	19,811,107	545,662,698
1812	773,032,496	18,622,590	29,244,711	556,284,819
1813	813,775,527	21,816,457	40,743,031	575,211,392
1814	907,495,950	24,763,646	93,720,423	644,168,169
1815	932,281,880	19,799,863	24,705,930	649,074,235
1816	1,003,090,282	20,647,122	70,888,402	699,315,516
1817	1,006,090,282	19,546,201	3,000,000	682,769,314
1818	1,109,123,032	18,512,227	————	748,201,991

The great addition in the last year arises from the consolidation of the British and Irish Exchequers, by which above L. 100,000,000 of stock were added to the mass, without, however, producing any virtual change in our finances; the interest of by far the greater part of the Irish debt having been previously paid in England. As the larger proportion of our debt bears only three *per cent.* interest, and is, of

National Income and Capital.

course, considerably below the value of L. 100 money for L. 100 stock, the value in cash of our debt would not (taking the three *per cents.* at L. 75) exceed L. 700,000,000, were there not a large addition to be made from Long Annuities and unfunded debt; the effect of which is to carry the value of the whole public debt in cash to nearly L. 750,000,000. But as there seems no more reason to anticipate the liquidation of the debt of England than of that of other countries, the more correct plan is to follow the French method of computing a financial burden by the amount of the annual interest. This, in our case, is above L. 46,000,000, if we include our annual payments to the sinking fund; or somewhat more than L. 31,000,000, if we leave that fund out of the question.

XIV.—*National Income and Capital.*

An inquiry into this subject, interesting to every civilized nation, is of vital importance to one so loaded with taxation as England, and still doubtful of the time when she may recover from the unparalleled burdens of the late contest. Mr Pitt, on first proposing the income-tax in 1798, made the following estimate of the annual income of England and Scotland:

ENGLAND—Rent of land, after deducting one-fifth,	L. 20,000,000
The tenants' income, deducting two-thirds of the rack-rent,	6,000,000
Tithes, deducting one-fifth,	4,000,000
Mines, iron-works, canals, timber, tolls, &c. deducting one-fifth,	3,000,000
Rent of houses, deducting one-fifth,	5,000,000
Profits of professions,	2,000,000
The same for SCOTLAND, taking it at one-eighth of England,	5,000,000
Income of persons residing in Great Britain, derived from our colonies,	5,000,000
Dividends from the public stocks, deducting one-fifth for exemptions and modifications,	12,000,000
Profits of trade, foreign trade,	12,000,000
——— home trade and manufactures,	28,000,000
	L. 102,000,000

This estimate was examined with great attention by the Reverend Dr Beeke,* who pointed out several heads, in particular tithes, which the minister had overrated; while in others, such as the rent of houses, his computation was below the mark. Since that period, the income of our countrymen, at least the income as represented in money, has experienced a considerable rise, and the returns under the *property-tax* have afforded a variety of useful *data*. We select the year 1810, as the latest return before the depreciation of our bank paper, and as equal (we fear more than equal) to the amount that would be declared in time of peace.

Rental of lands,	L. 29,500,000
Tithes,	2,360,000
Rental of houses,	13,000,000
Mines, quarries, and iron-works,	740,000
Trade and professions,	32,200,000
Interest of money in the public funds, or on mortgage; salaries from public offices, and all sources not already specified,	47,700,000
	L. 125,000,000

Such are the returns under the property-tax; but to this we must add a considerable sum for the deductions allowed by government on incomes between L. 50 and L. 200 a year, and a much greater for the wages of the lower orders. Of the population of England and Scotland, a vast proportion were wholly exempted from the property-tax, their incomes being below L.50 a year. Supposing that the property-tax, since the peace, would render somewhat less than in 1810, but that with the addition of the deductions for small incomes (from L. 50 to L. 200) the total return would be L. 130,000,000, and adding to this L. 70,000,000 for those wholly exempted, we have for England and Scotland an amount of L. 200,000,000; to which, adding for Ireland (which has never been subjected to property-tax), a conjectural amount of L. 25,000,000, the aggregate of the national income would be L. 225,000,000. This sum is considerably below the estimate of a writer of the present day (Mr S. Gray *on the Happiness of States*); but he makes no allowance for the depreciation consequent on the change from war to peace; and does not, moreover, distinguish between that which is income, and that which is properly created, or the annual produce of land and labour. This distinction will be best understood by transcribing from Dr Colquhoun's late work on the British empire, his

Estimate of Property created in Great Britain and Ireland in the year 1812.

Agriculture in all its branches,	L. 216,817,624
Mines and minerals, including coals,	9,000,000
Manufactures in every branch,	114,230,000
Inland trade in all its branches,	31,500,000
Foreign commerce and shipping,	46,373,748
Coasting trade,	2,000,000
Fisheries, exclusive of the colonial fisheries of Newfoundland,	2,100,000
Chartered and private bankers,	3,500,000
Foreign income remitted,	5,000,000
Total,	L. 430,521,372

A farmer's income is the profit resulting from his capital and labour; but the corn raised, or, in other words, the "property created" by him in the course of a year is obviously four or five times that amount. A manufacturer, in like manner, makes goods to an extent of probably ten times his income; so that the

* *Observations on the Produce of the Income Tax, and on its Proportion to the whole Income of Great Britain.* 1800.—Pamph.

Population.

two estimates,—we mean that of income and that of property created, accord only in the case of professions, of salaries, of wages; and the result is, that the total property created in a year is nearly double that of income,—a distinction which explains the misapprehension of M. Say and others who have taxed Dr Colquhoun with exaggeration.

What proportion does our taxation bear to our national means? Taking our taxes as fixed by the late acts (July 1819), and estimating them by their gross produce,—such being the payment by the people, and adding the amount of poor-rates, we have (without considering the corn-laws in the light of a tax, and leaving the sinking fund altogether out of the question) an annual burden of fully L. 70,000,000 Sterling, or one-third of the national income of Britain and Ireland!—while France, whose national income is at least equal to that of the three kingdoms, is subjected to a taxation of only half the amount.

The next topic in this inquiry regards the amount of national capital. We subjoin two calculations, both inclusive of Scotland, and both made in the early part of this century.

Mr Grellier's Computation.

Value of land in England and Scotland,	L. 828,660,000
Houses,	199,575,000
Cattle, and all kinds of farming stock,	102,500,000
	L. 1,130,735,000

Dr Beeke's.

Value of land in England,	L. 600,000,000	
——— in Scotland,	120,000,000	
Value of tithes in England,	75,000,000	
		795,000,000
Houses,		200,000,000
Farming capital,		125,000,000
Mines, Canals, Timber, Tolls, &c.		100,000,000
		L. 1,220,000,000

Mr Grellier went very little farther, but Dr Beeke makes several very important additions, viz.

Value (in 1800) of the public funds,	300,000,000
Value of our trade; home trade,	120,000,000
——— foreign trade and shipping,	80,000,000
Unproductive property; viz. furniture, plate, lands not yet cultivated,	280,000,000
Total of England and Scotland,	L. 2,000,000,000

To this Dr Colquhoun adds a conjectural estimate for Ireland; and, writing in 1814, computes the whole as follows:

	Productive Property.	Unproductive.	Government Property.	Total of each Country.
England and Wales,	L. 1,543,400,000	271,500,000	32,000,000	1,846,900,000
Scotland,	239,580,000	38,500,000	3,000,000	281,080,000
Ireland,	467,660,000	87,000,000	9,000,000	563,660,000
Military stores and other property common to Britain and Ireland,				45,000,000
Total of each kind of property,	L. 2,250,640,000	397,000,000	44,000,000	2,736,640,000

XV.—*Population.*

The population of England and Wales may be computed with considerable accuracy, so far back as 1377, from the returns of a poll-tax imposed that year; when the total of all ages and sexes appears to have been about 2,300,000. The succeeding century, passed in a great measure in civil war, could not be a period of large increase; but these contests were happily closed by the accession of Henry VII. in 1485, and followed, in the reign of his son, by the adoption of a religion more favourable to productive industry than the Catholic creed, with its endless holidays. These advantages, and the wise government of Elizabeth, render probable the great increase to be inferred from the survey made in 1575 (the season of dreaded invasion from Spain), the result of which seems to give an aggregate of 4,500,000. In the succeeding century, the chief *data* of computation are the official records of houses in the Hearth Office; from which it seems probable that the population of England and Wales, at the time of the Revolution, was between five and six millions. At last, in 1801, and again in 1811, clear and accurate returns were obtained, under acts of Parliament, when the total population of England and Wales was found to be

In 1801,	9,343,578
In 1811,	10,791,115

The increase, in ten years only, was 1,447,537, or at the rate of $14\frac{1}{2}$ *per cent.* for England, and 13 *per cent.* for Wales.

Return of 1811.

Inhabited houses,	1,797,494
Number of families,	2,142,147

Population.

Families employed in agriculture,	723,397
——— in trade, manufactures, and mechanical labour,	959,622
Towns, great and small,	939
Town population,	4,365,281
Country population,	5,785,334
Male inhabitants,	4,867,396
Army and Navy,	640,500
Total males,	5,507,896
Females,	5,283,219
Total population,	10,791,115

Inhabitants per Square Mile.

England, not 186, as has been stated, but	198
Ireland,	122
Wales,	80
Scotland,	56

Marriages, on an Average of Ten Years, from the Official Returns.

1755 to 1765,	56,275
1765 to 1775,	59,892
1775 to 1785,	65,479
1785 to 1795,	71,784
1795 to 1805,	79,231
1805 to 1810, (average of five years),	82,953

This increase of marriage is altogether a consequence of a previous increase of population; for it appears that the proportion of marriages among an equal number of persons has not augmented; the returns showing,

From 1780 to 1790, 1 marriage among 117 persons.
—— 1790 to 1800, 1 among 119½
—— 1800 to 1810, 1 among 119½

Population.

The average of deaths varies considerably, being much greater in towns than in the country. In Middlesex, there are 1 annually for 36 inhabitants; in Surrey, 1 in 45; in Lancashire, 1 in 48; while, in the healthy agricultural districts, they do not exceed 1 in 60; and, in Wales, rise still higher, being only 1 in 64 or 67. Still the ratio of increase in population is much larger in towns, owing apparently to two causes—the greater frequency of marriages, and the incessant removal of persons from country to town.

Population of the Principal Towns of England.

	Year 1801.	Year 1811.
London,	900,000	1,050,000
Manchester,	81,020	98,573
Liverpool,	77,653	94,376
Birmingham,	73,670	85,753
Bristol,	63,645	76,433
Leeds,	53,162	62,534
Plymouth,	43,194	56,060
Portsmouth,	32,166	40,567
Norwich,	36,832	37,256
Sheffield,	31,314	35,340
Nottingham,	28,861	34,253
Bath,	32,260	31,496
Newcastle-upon-Tyne,	28,365	27,587
Hull,	29,516	26,792
Bolton,	17,416	24,149
Leicester,	16,953	23,146

For an account of the Laws of England, and of the administration of Justice, we must refer to the articles Law and Court in the *Encyclopædia*; and to the articles King, Lords, Commons, and Parliament, for an account of the form of Government, and of the powers and functions of the different branches of the Legislature. (D.D.)

ENTOMOLOGY.

Entomology (from ἔντομον an insect, and λογος a discourse) is the name of a science, embracing the study of all such annulose animals as have articulated legs; namely of *Cirripides, Crustacea, Myriapoda, Acari, Arachnoïda*, and *Insecta*.

Under the head Annulosa (Vol. I. p. 401—429—482 and 447) we have already given a rapid sketch of the principal systems that have been proposed by various authors. In the present article it is our intention to exhibit an historical view of the rise and progress of Entomology, and to enumerate, with general remarks, all the works and dissertations that have come under our view.

Of the most ancient writers on this subject we are totally ignorant; we know only that insects were not unnoticed by Moses, who frequently alludes to them in the sacred writings; and it is said that Solomon cultivated this as well as other branches of natural history.

Linus, a poet of Thebes, is the first author who is recorded to have described all animals and plants. After him, Orpheus, Anaxagoras, Archelaus, Democritus, and Hippocrates, are quoted by Pliny and other authors, as having studied Insects; but we believe that none of their works on this subject are now extant.

Aristotle wrote on insects. In the seventh chapter of his first book, we find his ἔντομα accurately distinguished from the other animals of the group of exsanguineous animals, with which he arranged them. In the first chapter of the fourth book, the essential external characters are more clearly given; namely, the incisions on the back and belly, &c. In another part of his work, he describes them as being composed of three parts, the head, trunk, and abdomen; and mentions their legs. In subsequent passages, he describes insects that fly, and those that walk. Amongst the former, he notices those with naked

and those with sheathed wings; he observes, too, that some have these sheaths divided, and others immoveably connected; he distinguishes also insects with two and insects with four wings; and observes that the latter are often furnished with stings, whilst the former are always destitute of these weapons. The modifications in the form of the antennæ and legs of insects, he has likewise described with accuracy. A cursory perusal of this work will astonish the modern Entomologist, who will be surprised at its consistency, and with the accordance of the author's divisions with the present systems of Entomology. Alexander the Great furnished Aristotle with means of cultivating science, which no other philosopher ever enjoyed; yet, notwithstanding these advantages, and his astonishing powers of mind, his writings contain too great an accumulation of knowledge, to have been the result of his individual inquiries: and we are perfectly convinced, from the slow manner in which all human knowledge is developed, that the study of nature must have made very considerable advances before his time; and that he must have derived assistance, either from his pupils, or from the labours of more ancient naturalists.

Speusippus and Leonides, pupils of Plato and Aristotle, are quoted by Athenæus, as having turned their attention towards Insects.

Xenocrates, who lived in the 110th Olympiad, in his six books on Nature, treated of Insects.

Theophrastus, too, an auditor of Plato and Aristotle, notices Insects in his writings.

Antigonus, who flourished under Ptolemy II. in a work, which was published at Leipzic in 1791, alludes to the manners of Insects.

Amongst the Greek writers who immediately, or within a few centuries, followed Aristotle, treating on Insects, we find quoted the names of Democritus, Neoptolemus, Philistus, Nicander, and Herodius. These writers are supposed to have been contemporary with Pliny; and, during the same period, several Latin writers seem to have pursued the science through the influence of the Greeks, who were insensibly led to it, from their culture of bees, which was at that time attended to with the most enthusiastic ardour. Aristomachus is said to have written on the subject, from the result of fifty years experience; and Philiscus to have employed his whole life in deserts and forests attending to their history.

Publius Nigidius Figulus, who flourished about sixty-four years before the birth of Christ, wrote a work on animals, in which insects are sometimes mentioned.

M. T. Varro, contemporary with Cicero, in his work, "De re Rustica," is the first Roman author who mentioned Roman insects, and Cicero, himself, has not unfrequently noticed insects in his "De Natura Deorum."

P. O. Naso, born in the first year of our era, is quoted as an Entomologist.

L. J. M. Columella lived under the Emperor Claudius, and, in his work, "De re Rustica," takes notice of various insects.

Pliny, the most celebrated of all the Roman naturalists, in the eleventh book of his Historia Naturalis treats of Insects. His observations on this subject are chiefly copied from Aristotle, and he has made use of the observations of various other writers, whose works he quotes; and has sometimes described species with tolerable exactness. Insects, indeed, seem to have occupied a considerable portion of his attention, and to have been a favourite study. "*In his,*" says he, "*tam parvis tamque fere nullis quæ ratio! quanta vis! quam inextracabilis perfectio!*" In his day, the culture of silk-worms was an object of peculiar attention: He says that garments of silk were very much admired by the fair part of the community, as they showed their form to great advantage. Pliny has frequently described the economy of animals with very great accuracy, but he has often admitted, on the authority of others, the most absurd and improbable fables.

Claudius Ælianus, a Roman who flourished under Adrian in 120, wrote twenty-seven books on animals, entitled Περὶ ζώων, and has appropriated several chapters to Insects, describing the generation of wasps, &c. often accompanied with fiction.

From the time of Ælian until the overthrow of the Roman Empire, the study seems not to have been totally disregarded; but we are ignorant what progress was made during that period; between which and the middle ages, we find the names of Titus, Ætius, Alexander, Oribasius, Trallian, Paulus Ægineta, Lucius Apuleius, Athanæus, Oppianus, Marcus Aurelius Olympius, St Ambrosius, Epiphanus Cyprius, Decius Magnus Ausonius, Æmilius Marcus, Merboldus, and Cassiodorus Isodorus, whose works contain general remarks on Insects, more or less mixed up with fiction.

Between the ninth and twelfth century, some of the Arabian botanists distinguished themselves as Entomologists. The principal were Rhazes, Avicenna, Avenzoar, and Averrhoës. From this period until the fifteenth century, a few obscure writers, scarcely worthy of notice, appeared; viz. Myrepsus, Platerus, and Lianus.

About the twelfth century, Hildegardis de Pingua wrote four books, entitled "Physica St Hildegardis," published in 1533 and 1544 in folio.

In the thirteenth century flourished Albertus Magnus, who wrote a work, entitled "De Naturis Animalium," part of which treats of Insects, in an obscure and barbarous manner. His works, in twenty-one volumes folio, were published at Lyons in 1657.

In the same century lived the celebrated Vincentius Bellouacensis, a French philosopher, who likewise cultivated the study of Insects.

Some time in the fourteenth century, an obscure work, entitled "Jorath De Animalibus," was written, and in the same æra also, another work, "De Natura Rerum," both of which mention insects.

About the middle of the fifteenth century, Theodorus Gaza translated the works of Aristotle on animals into Latin. Towards the end of the same century, Hermolæus wrote "Castigationes Caii Plinii." Romæ, 1492 et 1493, Basil, 1589; of which there were also several other editions. Jonannes Cuba, author of a work entitled "Hortus Sanitatis," &c. Argent, 1536, is supposed to have lived in the same æra.

Agricola, in 1549, published a systematic arrangement of Insects in his work "De Animalibus Subterraneis," in which he reduces all insects to three principal classes, viz. 1. Those that walk. 2. Those that fly. 3. Those that swim; and describes a number of species.

In the beginning of the sixteenth century, Gregorius wrote his excellent work in German, on Birds and Fishes, of which there is a Latin edition. Insects are mentioned in this work.

In this year appeared a work by Paulus Jovius, "De Piscibus Romanis," Basil, 1531; of which a second edition was published at Rome in 1524.

Petrus Gyllius, a Frenchman, published "De Natura Animalium," Lugd. 1533.

In this year the celebrated Conradus Gesner published his "Historia Naturalis:" A work to be consulted by the Entomologist. Gesner was born in 1516, and died in 1558.

In 1552, Edward Wotton published his work "De differentiis Animalium," Paris, 1552, in which he treats largely on Insects. The book is in folio, and appeared three years before the author's death.

Rondeletius this year produced his little work, "De Piscibus Marinis, cum universa Aquatilium historia, et de Insectis et Zoophytis." Lugd. Gall. 1554; and, in the following year, published his "Universa Aquatilium historia pars altera." Ludg. Gall. 1555, fol. The third book of which treats of Insects, and is accompanied by rude wood cuts.

Petrus Andreas Matthiolus in this year published his "Commentarii de Medica Materia," &c. Venet. 1583, which is illustrated with figures.

A little work by Gesner, entitled "Serpentiam Historia et Insectorum Libellus," was published in this year.

In this year appeared "Ferrante Imperato dell' Historia Naturale." Naples, 1599. And "Xenocrites De Natura, Libri sex. Cura Gesneri." Turici, 1559.

Ulysses Aldrovandus published a very voluminous work, "De Animalibus Insectis," Bononiæ, 1602. fol. This indefatigable compiler has certainly acquitted himself very well in collecting together the undigested observations of the ancients, considering how entirely he was ignorant of the subject himself. He has consequently fallen into all the errors of his predecessors; but has very rarely omitted to mention his authorities. He was professor of medicine at Bologna, and spent much of his time and money in acquiring insects and in employing artists to figure them. He is stated to have paid two hundred florins annually to an artist, who was solely occupied in the delineation of Insects. Aldrovandus divides insects into two great groups, 1. Terrestrial; 2. Aquatic, which he terms Insecta farica, and non farica; these he again distributes into minor groups from the number and situation of their wings and feet. His figures are but rudely executed; but as the art of engraving on copper had at that period but scarcely emerged from its infancy, such works were almost exclusively produced by artists themselves.

Wolfang Franzius published, in 1612, his "Historia Animalium Sacra," in which insects are divided into, 1. Aëria; 2. Aquatica; 3. Terrea; and are described with greater accuracy than in any former work.

A pamphlet of about an hundred pages, entitled "Jeremiah Wilde De Formica," appeared in Rome.

In 1622, a work but remotely relating to Insects was published in Edinburgh, bearing the following title, "Hieroglyphica Animalium Terrestrium, &c. quæ in Scripturis Sacris inveniuntur et plurium aliorum, cum eorum interpretationibus." 4to.

A thin quarto, containing 226 miscellaneous figures of insects, was published under the title of "Diversæ Insectorum volitantium Icones ad vivum depictæ, per D. J. Hoefnagle, typisque mandate a N. J. Vischer."

The work of Thomas Mouffet, entitled "Insectorum sive minimorum Animalium Theatrum." Londini, 1634. fol. This is the first work on Entomology published in Britain; it is ornamented with several wooden cuts, rudely executed, accompanied by long, tedious, and often fanciful descriptions of the species. The first seven chapters are occupied with heavy details concerning the common hive bee (Apis mellifica). The eighth is entitled, "De Vespis:" the ninth, "De Crabrone et Tenthredine," which includes descriptions of the humble-bees (Bombi). The three following chapters, "De Muscis," under which are comprehended several Dipterous, Hymenopterous, and Neuropterous insects. The thirteenth, "De Culicibus." The fourteenth, "De Papilionibus," which occupies two hundred pages, the margins of which are embellished with one hundred and twelve wooden figures, executed in the rudest style; yet in most instances they are tolerably intelligible. The fifteenth, "De Cicindela," including the glow-worm (Lampyuris) and several other genera. The seventeenth, "De Locustis." The eighteenth, "De Blattis." The nineteenth, "De Buprestide et Cerambyce." The twentieth, "De Cantharide." The twenty-first, "De Scarabæis," including several of the larger Coleoptera. The twenty-second, "De Scarabæis minoribus." The twenty-third, "De Proscarabæo et Scarabæo aquatico." The twenty-fourth, "De Gryllo-talpa." The twenty-fifth, "De Phryganea." The twenty-sixth, "De Tipula." The twenty-seventh, "De Forficula sive Auricularia." The twenty-eighth, "De Scorpioni, Formica, et Pediculis alatis;" and lastly, the twenty ninth, "De Cimice Sylvestri." We then arrive at the second book, which treats of apterous insects, amongst which he arranges all sorts of larvæ or caterpillars, and several vermes. We must apologise to the reader for having taken up so much of his time with the above dry extracts; but as they occur in the earliest of our works, we trust they will not prove entirely uninteresting. We shall conclude with quoting the following passage, relating to a species of *mantis*, as a specimen of his style and notions relative to the subject: "Pectus habet longum, tenue, cuculo tectum, caput simplicem; oculos sanguineos, satis magnos; antennas breves; pedes sex locustarum more, sed anteriores multo crassiores longioresque cæteris, quos quia junctos plerumque elevat (præcantium ritu a nostratibus *presque Dieu* dici solet;

totum corpus macilentum est. Tam divina censetur bestiola, ut puero interroganti de via, altero pede extenso rectam monstrat, atque raro vel nunquam fallat. Cauda illi bifurca, setaceis duobus aculeis prædita; atque ut manuum elevatione vates refert, ita etiam et motus similitudine; neque enim ludit ut alii, neque saltat, neque gestit; sed lente obambulans modestiam retinet et maturam quadam ostendit gravitatem." This work is professedly an improvement on that of Dr Wotton, begun in 1550, continued by Gesner, and afterwards published in its present form by Mouffet.

In 1646, Hollar gained considerable reputation by his work, " Muscarum, Scarabæorum, Vermiumque variæ Figuræ et Formæ, omnes ad vivum coloribus depictæ," &c. Antwerp.

In this year, Johnson published his "Historia Naturalis" in folio; but, as this work is a mere compilation, without a single new remark, it is unworthy of further notice.

An English translation of Mouffet's work was published in London by Topsal.

Dr Mey, minister of Middleburgh, published a Latin translation of Goedart's work, entitled, " Metamorphoses et Historia Naturalis Insectorum, 1662."

In 1664, a quarto relating to insects as objects of microscopical observation, by Power, was published.

In 1665, " Hook's Micrographia" appeared, treating of minute insects.

C. Merret, in 1667, published in London his celebrated " Pinax rerum naturalium Britannicarum, continens Vegetabilia, Animalia et Fossilia, in hac Insula reperta inchoatus." As this is the earliest book treating exclusively of British insects, it is not devoid of interest. It contains a brief catalogue of such species as were known to Dr Merret, with a concise descriptive sentence, by way of name. In the first volume of the " Transactions of the Entomological Society of London," an account of the insects enumerated, with their systematic names, is given by Haworth.

Charlton produced his " Onomosticon Zoicon." London, 1668, 4to, which contains a systematic arrangement of insects after the manner of Aldrovandus.

In 1669 was printed in Dutch, with a Latin title, at Utrecht, " Historia Insectorum Generalis," &c. by the celebrated Swammerdam. This work was printed in quarto illustrated with thirteen copperplates. Many years elapsed before this great work, the admiration of later times, was in any manner acknowledged. It was condemned as inaccurate until the death of its learned author; but no sooner was his death announced, than his value was discovered, and his work was translated into the French language. This was shortly after followed with other editions. Swammerdam divided insects into four groups, the characters being taken from their metamorphosis and economy. The first undergo no change, such as *spiders*, *onisci*, &c. (The classes *Crustacea*, *Myriapoda*, *Arachnoïda*, and *Acari*, of the moderns.) The second includes those which, after leaving the egg, appear under the form of the perfect insect, but have no wings, in which state they eat and grow, till, having shed their skin, they appear in the winged form, and are capable of propagating their kind. (The orders *Orthoptera*, *Dermaptera*, *Dictuoptera*, *Hemiptera*, and some of the *Neuroptera*.) In the second group are comprehended those insects which appear, when hatched from the egg, under the form of a caterpillar, which, when full grown, changes into a chrysalis, where it remains until the parts are fully developed. The insects included under this head are, the orders *Coleoptera* and *Aptera*. The fourth group comprehends those who, having attained their pupa state, do not divest themselves of their skin, namely the *Hymenoptera* and *Diptera*.

Wolf's " Dissertatio de Insectis," &c. was published at Leipsic, during the same year. The author was Professor of Medicine at Jena.

In 1661 was published, in 12mo, " Redi Experimenta circa generationem Insectorum," in which the long maintained and ridiculous doctrine of equivocal generation is most successfully overthrown.

Claude Perrault, one of the most learned exotic Entomologists of his age, author of several very valuable papers in the " Memoirs of the French Academy," published a folio work in Paris, entitled, " Memoires pour servir à l'Histoire Naturelle des Animaux," 1671.

In 1672, Ferrard published a work on Insects, at Naples. We have never met with it, but it is highly spoken of.

Franzelio, in 1673, submitted his " Insecta Novisolii cum nive delapsa" to the world.

In the same year, Mollerus published at Franckfort, " Meditatio de Insectis quibusdam Hungaricis prodigiosis anno proxime præterito, ex aëre una cum nive in agros delapsis," ornamented with wooden cuts.

Swammerdam published, in 1675, a tract on the natural history of the *Ephemera horaria*, entitled, " Ephemeri Vita."

In the same year, an elementary tract was printed at Upsal, by G. Belerio, named, " περὶ τῶν εντόμων."

And about the same time, by Samuel Bochart, a work entitled, " Hierozoicon, sive bipartium opus de Animalibus Sanctæ Scripturæ."

In 1676, some additions to Claude Perault's work were published.

In 1691, Madame Maria Sybilla Merian, or Gräffinn, produced the first part of her work, " Der Raupen wunderbare verwandelung und sonderbare blumen-nahrang," which relates principally to European insects, of the order Lepidoptera. The authoress was a native of Frankfort on the Maine, wife of John Andrew Gräffinn. In early life she imbibed a taste for the study of insects, from being occupied at times in painting these objects as ornaments to her flower-pieces, in which she is said to have excelled. The task of painting insects she performed with tolerable accuracy; yet there is a wireiness in the outline, and " a peculiar exuberance of style, incompatible with any faithful resemblance of nature." Many of her original drawings are preserved in the British Museum, as specimens of her performance.

In 1680 was published, " Johannis Jacobi Wagneri, Historia Naturalis Helvetiæ curiosa," with figures.

Grew, in 1681, published his " Museum Regalis

Societatis," being a catalogue, with descriptions of the natural and artificial curiosities, belonging to the Royal Society of London, preserved in Gresham College. London, folio.

In the same year, an English translation of Swammerdam's "Ephemeri Vita" was published in London, and a French translation in Paris.

In 1682, a book, entitled, "Johannes Godartus of Insects, done into English, and methodised, with the addition of Notes; the figures etched in copper, by Mr P. Fib;" was published at York. It is supposed to have been translated by Martin Lister; the initials M. L. being at the close of the address to the reader. The impression, as we learn from the preface, consisted of one hundred and fifty copies, which were intended merely for the curious. The notes are copious.

Hoppis, in the same year, published a Dissertation on the Migratory Locust.

In 1683, the second part of Merian's "Der Raupen," &c. appeared.

In 1685, the first Latin edition of Swammerdam's great work was printed in Lyons, under the title, "Historia generalis Insectorum, Latinam fecit H. C. Hennius."

In this year also, Lister's Latin edition of Goëdart, entitled, "J. Goedartius de Insectis in methodum redactus, &c. Opera, M. Lister, &c. Item Appendices ad Historiam Animalium Angliæ, Ejusdem M. Lister, Londini, 1685," 8vo. Illustrated with several copperplates. In this work Lister has distributed the materials of the work into a new form of arrangement, the merits of which are too obvious, not to be considered as an important improvement on the original production. He divides them into ten sections, as follow:

1. Those with erect wings and angulated pupæ. *Butterflies.*
2. Those with horizontal wings, proceeding from caterpillars, called by Goedart, *Geometræ.*
3. Those with deflexed wings, *Moths.*
4. Libellulæ, or dragon-flies.
5. Bees.
6. Beetles.
7. Grasshoppers.
8. Flies with two wings.
9. Onisci or Millipieds.
10. Spiders.

Although we allow to Lister all the credit due for this arrangement, yet we cannot avoid expressing our regret at his remarks on the original author, to whom he allows neither credit as a naturalist nor as a writer. He highly praises his skill as a painter; but says, "Goedart, after forty years' attention, seems to have made but little advancement in his skill in the nature of insects; he rather appears to have diverted himself, than to have given himself any trouble to understand them; and yet, after all, you will find him every where just and correct, but in many places short and hardly intelligible." These opinions are delivered in a style of highly unbecoming affected superiority over his author, and have gained him no reputation on the Continent, where he has been much neglected and condemned for his illiberality.

In 1687, Leuwenhoek produced his "Anatomia seu interiora rerum, cum animitarum tum inanimitarum, ope et beneficio exquisitissimorum microscorum detecta."

Geyereus, in the same year, wrote a treatise on the medical effect of Spanish flies (Cantharides), entitled, "Tractatus Physico-medicus de Cantharidibus."

J. F. Griendel, about the same period, published at Neuremberg, in quarto, "Micrographia Nova," in which some notice is taken of insects.

In 1688 was published an Italian edition of Redi's experiments, entitled, "Esperienze intorno alla Generazione degl' Insetti."

In this year also, Stephen Blankaart of Amsterdam published a work, "Schon Berg der Rupsen, Wormen, Maden en vliegende Dierkens daar uit voort-kommende." The author was a physician, who devoted much of his time to collecting insects. The plates are admirably executed; but the work in other respects bears but a very indifferent character. It treats of the larvæ of various insects, and a few in the perfect state are also noticed. Frisch and Lyonet consider it but a superficial production. Another edition was published at Leipsic in 1690.

John Cyprien also published at Frankfort, "Historia Animalium," in the same year, in which insects are noticed.

About this period, two papers on insects are mentioned as having been published, one by John de Muralto, the other by C. Mentzelius.

In 1690, Bilberg published, at Upsal, a dissertation, entitled, "Locustæ."

Also König's "Regnum Animale."

And Stephanus Blancard published, in 8vo, at Leipsic, his "Schon-burg der Ruspen, Wormen, Maden."

In 1691, the "Historia Vermium," by Jungius, was printed at Hamburgh.

In 1692, in the "Memoirs of the French Academy," we find a curious paper, by Sedileau, entitled, "Observations sur l'Origine d'une espéce de Papillon," which treats of *Saturnia Pavonia-major.*

In 1693, an augmented edition of Swammerdam's work was printed at Utrecht, entitled, "Historia Generalis Insectorum, Latinam fecit H. C. Hennius."

In this year, the prodigious ravages occasioned by immense swarms of locusts, which, in the month of August, over-ran Germany, and extended partially through the rest of Europe, even to the northern borders, could not fail to engage the notice of many writers, amongst whom we find the following accounts. "Heberstreit; de Locustis immenso agmine aërem nostrum implentibus, et quid portendere putentur." This treatise is comprised in sixty-five pages, with one plate, from which we learn the species treated of to be *Locusta migratoria.* "Lodolphi Dissertatio de Locustis, anno præterito immensa copia in Germania visis, cum diatriba, qua sententia autoris de שלוים defenditur." In folio, consisting of eighty-eight pages, embellished with figures. The following authors also published tracts on this subject, namely Crelluis, Kirkmajor, Wollen-

haupt, and Treunera; but we are ignorant of the titles of their little dissertations.

In 1694, Albino published a small tract on the Spanish flies (Cantharides).

In 1695 appeared the "Arcana Naturæ Detectæ," by Leuwenhoek.

And, in the same year, a small octavo, "Jacobi Petiveri Museum."

In 1699, Hombergh published a paper in the Memoirs of the French Academy, on *Agrion Virgo*, Fabr.

In 1700 was published, in 3 vols. duodecimo, "Histoire Naturelle des Insectes selon leurs différentes metamorphoses, observées par Jean Goedart. Amsterdam."

James Petiver, in 1702, produced the first decade of his "Gazophylacium Naturæ et Artis," which was carried on progressively during ten years. It consists of ten parts, which treat of insects, as well as of various animals, fossils and plants.

In 1705, our celebrated countryman Ray published his work entitled "Methodus Insectorum, seu in methodum aliqualem digesta."

In this year, also, the entomological part of the work of Rumphius appeared.

In 1707 appeared in London "A Voyage to the Islands of Madeira, Barbadoes, Jamaica, with the Natural History," &c. by Sir Hans Sloane, folio.

In 1710, Russel published his "Theatrum universale omnium Animalium," which treats of insects.

And in this year appeared Ray's posthumous work, "Historia Insectorum," which was brought out under the care of Dr Derham. Insects are defined to be animals, having their bodies divided more or less by incisions. The first division, ἀμεταμορφωτα, undergo no change, and consists of, 1. Ἄποδα, or those without legs, under which he comprehended the class Vermes (Anneleides *Cuvier*), and some intestinal worms (*Entozoa*); 2. Pedata, including the classes Arachnoïda, Myriapoda, Insecta Ametabolia, and some of the Crustacea Malacostraca Edriophthalma. The second division, μεταμορφωτα, pass through the state of larva, and contains all the Insecta Metabolia.

In 1717, Wedelio published a tract of the utility of Cantharides, in the Materia Medica of Jena.

In the same year, J. Petiver published a work in London, "Papilionum Britannicæ Icones, Nomina," &c. folio. This was certainly, in its day, a valuable acquisition to the student, and is still, as a work of reference, of some repute.

Frisch, in 1720, published his "Beschreibung von Insecten in Deutschland." The whole work consists of thirteen parts, illustrated, each, with plates.

Eleazer Albin published, in London, "A Natural History of English Insects," with one hundred copperplates, in one quarto volume.

In 1721, Bradley published, in London, "A Philosophical Account of the Works of Nature," which contains some entomological matter, and a few engravings of insects. 8vo.

In 1722, Opera Omnia Leuenhoekii.

Sir Hans Sloane published in London, in 1725, the second volume of his "Natural History of Jamaica," the second book of which treats of the insects of that island, and is accompanied by several plates.

In 1726, Madam Mérian published at the Hague, in large folio, "De Generatione et Metamorphosibus Insectorum Surinamensium," the materials of which were collected by herself, or under her immediate direction, in Surinam, where she spent two years, for the sole purpose of forming a collection, and in taking drawings for this work; which is not, however, entirely devoted to Entomology, for, besides insects, we find plants, and various reptiles, as toads, lizards, serpents, &c. depicted.

In 1730, Valisnieri, in his "Esperienze et Observationi intorno agli Insetti," distributes all insects into four groups, from the following characters: 1*st*, Those living on plants: 2*dly*, Those living in water: 3*dly*, Those living on the earth, or amongst stones: 4*thly*, Those which subsist on other animals.

Eleazre Albin, in 1731, published, in a quarto volume, "Insectorum Angliæ Historia Naturalis illustrata Iconibus in centum tabulis æneis eleganter ad vivum expressis," &c. which came out in London, and was esteemed an elegant work. It is more remarkable for gaudiness than fidelity.

And, in the same year, in London, "Histoire Naturelle de la Caroline, la Floride," &c. par Marc Catesby, folio.

Reaumur published, in 1734, the first volume of his valuable "Memoires pour servir à l'Histoire des Insectes," in Paris. The five succeeding volumes appeared between that time and 1742.

In the same year, the first volume of the celebrated "Alberti Sebæ, Locupletissimi rerum Naturalium Thesauri accurata descriptio, et Iconibus Artificiosissimis, Expressio Latiné et Gallicé," folio. The three succeeding volumes appeared before 1765.

In 1735, the celebrated Swedish naturalist Linnæus published the first edition of his "Systema Naturæ, sive Regna tria Naturæ systematice proposita per Classes, Ordines, Genera et Species," in which work he distributes insects into four orders, according to the number and form of their wings, under the names, 1. Coleoptera, or insects with covered wings. 2. Angioptera, those with naked or uncovered wings (such as the modern orders *Lepidoptera*, *Trichoptera*, *Hymenoptera*, and *Diptera*). 3. Hemiptera, comprehending the modern orders *Hemiptera*, *Homoptera*, *Orthoptera*, and *Dictuoptera*. 4. Aptera, including the orders of insects now named *Aptera*, *Thasynura*, and *Anoplura*, as well as the classes *Crustacea*, *Myriapoda*, and *Arachnoïda*, and part of the classes *Vermes* and *Echinodermata*. In this latter order, he by no means deviated from the received opinions of his time. In the subsequent editions of this work, the Vermes and Echinodermata are separated, and constitute, with the true Mollusca, and the Entozoa, his class Vermes. See the year 1767, under which head, when speaking of his twelfth edition, his final views will be duly noticed.

In 1736, all the works of Swammerdam were put to press, entitled "Biblia Naturæ, sive Historia Insectorum Belgiæ, cum versione Latina, H. D. Gaubii, et vita auctoris, per A. Boerhaave." The first vo-

lume appeared in 1737, and the second in the year following.

Lesser, in 1738, published a work entitled "F. C. Lesser's Insecto-Theologia, oder Vernunft und Schriftmässiger Versuch wie ein mensch durch aufmercksame Betrachtung derer sonst wenig geachteten, Insecten, &c. Frankfort und Leipzig." 8vo. It was translated into French in 1742.

The folio work of L'Admiral, entitled, "Naawkeurige Waarneemingen van Gestaltvermisselende gekorwene Diertjes," was published in Amsterdam. It contains a series of highly finished etchings, some of which have been copied by Harris, in his Aurelian. This work is confined to the insects of Europe, and contains figures of about fifty of the larger species, principally of Lepidoptera, which are represented in various attitudes, with branches of the plants in which their larvæ feed, accompanied, in some instances, with figures of their larvæ and pupæ. Most of the copies contain but twenty-five plates, and five pages of letter press; but we have seen one copy containing thirty-two plates, and twenty pages of description.

In 1741, Schæffer published his "Icones Insectorum circa Ratisbonam Indigenorum," in three volumes quarto, the plates being coloured. The classification of this author differs from that of Linné, and approaches to that proposed by Geoffroy in some points. He divided insects into seven orders, which he termed classes: 1. *Coleoptero-Macroptera*, those with their elytra crustaceous through their whole length, and extending beyond the abdomen when closed. 2. *Coleoptera-Microptera*, those with crustaceous elytra shorter than the abdomen. 3. *Coleoptero-Hymenoptera*, such as have their elytra half crustaceous, or becoming, towards their extremities, membranaceous. 4. *Hymeno-Lepidoptera*, insects with transparent or membranaceous wings, imbricated with scales. 5. *Hymeno-gymnoptera*, those with four naked membranaceous wings. 6. *Diptera*, insects with two wings. 7. *Aptera*, those without wings.

Lesser's Insecto-Theologia was translated by Lyonnet a la Haye into French in 1742, 8vo, entitled, "Theologie des Insectes, ou Demonstration des Perfections de Dieu dans tout ce qui concerne les Insectes." The views of the author and translator are to promote the glory of God, nor do either of them attempt to establish any new entomological fact, but have directed their attention to the relating of such anecdotes relative to the natural history of insects, as could be rendered a convenient medium for the theological remarks with which the pages abound. To the entomologist the work is useless, as the remarks are often erroneous; but, as a theological publication, it doubtless had a useful tendency at the time in which it appeared. One of the best chapters relates to the abuse of inquiries about insects in theology, in which several of the fables invented by the Rabbis concerning the erection of Solomon's temple, &c. as well as the legends of Catholic superstition, equally fraught with folly, are most successfully combated.

Detharding, also, in the same year, published a small treatise relating to the larvæ of moths, entitled "Disquisitio Physica Vermium in Norvegia qui nova visi."

George Edwards, in 1743, published the first volume of his "Natural History of Uncommon Birds, and of some other rare and undescribed Animals." London, 4to. Three other volumes appeared before 1752, in which several insects are figured.

In 1744, at Stockholm, was published by De Geer, an interesting little work in octavo, entitled, "Tal om nyttan, som Insectere ochderas sharshadande, tilskynda oss," pointing out the advantages of cultivating the natural history of these animals. It is, as far as we know, the oldest work on this subject.

In 1745, at Stockholm and Upsal, by Linnæus, a small octavo volume, entitled "Olandska och Gothländska Resa förrättad är."

In 1746, "Der Montalich-herausgegebenen Insecten Belustigung," by Rösel of Nuremberg, a man of genius, who was by profession a miniature-painter. The work is in quarto. Two other volumes appeared in 1749 and 1755. To these a fourth volume was added by a relation (Kleemannir) after his death in 1761; and since that period, Kleemanahus published three other parts.

In 1747, a tract explaining the advantages arising from the study of insects, entitled "Dissertatio de Usa Cognitionis Insectorum," was published by C. F. Menander.

John Gould, in the same year, published, in London, "An Account of British Ants."

And Bazin published, in Paris, his "Abrégé de l'Histoire des Insectes, pour servir de suite à l'histoire naturelle des Abeilles." Paris. In two volumes duodecimo.

Adrian Gadd, too, published in quarto, "Observationes Physico-Œconomicæ, in Septentrionali præfura territorii superioris Satagundiæ collectæ. Dissertatio Præside C. F. Menander, Aboæ," an interesting tract, explaining the advantages arising from the study of natural history.

In 1748, was published in London, by J. Dutfield, six numbers of "A Natural History of English Moths and Butterflies."

And two small tracts, by T. C. Hoppe, "Antwort-Schreiben auf Hern Schreibers zweifel; Gera." —"Eichen Weiden und Dorrosen;" Leipsic.

In 1749, Linnæus published "Skänska Resa."

And, in the same year, or perhaps earlier, the work of Benjamin Wilks, entitled "The English Moths and Butterflies, together with the Plants on which they feed, and are usually found." The plates which appeared first bear no date. The greater portion of this publication is copied from the first volume of Rösel, from Albin, Merian, and other writers of his day; but this imposition on the public was not discovered in England; it was first pointed out by Rösel, in the third volume of his "Insecten Belustigung." Wilks also published "Twelve new designs of Butterflies," a work of no use to science, although sometimes quoted by writers on Entomology.

In 1752, Dr Hill, in his "History of Animals," London, divides insects into three classes; the first *Apteria* includes all insects without wings; the se-

 cond *Pteraria*, is devoted to the winged insects; the third *Gymnanthridia*, comprehends those with soft and naked bodies.

De Geer also, in this year, published the first volume of his invaluable work "Memoires pour servir à l'Histoire des Insectes," at Stockholm, which was received with every demonstration of praise to which its merits entitle it. From the testimony of the author's abilities, afforded by this volume, the continuation was expected with impatience; but nine years elapsed before the second volume appeared, and it was altogether twenty-six years from the commencement to its termination. It was completed in 1778, in which year the labours of its author closed with his life. He was author of several papers in various Transactions, which we shall notice in their proper places.

In the same year, Linnæus published two dissertations at Upsal, "Miracula Insectorum," and "Noxia Insectorum." The latter of these is very valuable, from the object in the contemplation of the author; and the first is not destitute of merit.

Scopoli, in the year 1753, produced his "Entomologia Carniolica," in which he distributes all the insects of which he treats into orders, genera, and species, nearly after the manner of Linné. As a systematic work, this publication is of little importance; in other respects it is valuable.

In this year also, "Novæ Insectorum Species, R. J. Uddman. Aboæ." 4to.

In the year 1754, Kalm, a learned botanist, published a paper on a species of Cicada, in the Swedish language, but we are unacquainted with its title.

In 1756, in folio, "Brown's Civil and Natural History of Jamaica."

F. Hasselquists published his "Iter Palæstinum" at Stockholm.

In this year, an English translation of one of the works of Swammerdam was published in London by Thomas Fleoyd.

In 1759, "Caroli Linnæi Animalium Specierum, &c. in formam Enchiridii, Ludg. Bat." 8vo.

In 1760, "Caroli a Linné Amœnitates Academicæ. Holmiæ." Volume V. 8vo.

In 1761, Linnæus produced his "Fundamenta Entomologiæ," being an introduction to the study of the science.

In this year likewise, an interesting work, "Insecta Musei Græcensis," was given to the world by Nicolaus Poda, containing an account of the Insects of Greece, after the Linnean manner.

J. H. Sulzer, in the same year, produced an introductory work to the study of Insects, in quarto, illustrated by several plates, under the title, "Die Kennzeichen der Insekten nach Anleitung der Ritters, Karl Linnæus, durch 24 Kupfertafeln erläutert, und mit derselben natürlichen geschichte begleitet." Zurich.

And Linnæus his "Fauna Suecica editio altera auctior."

Also Martinus Thrane, "Prodromus Insectorum Siællandicæ, Hafniæ." 8vo.

Sepp, in 1762, began his "Beschonaring per Wondern Gods in de Minstgeachte schepzelen of Nederlandsche Insecten," which is dedicated to Dutch Lepidopterous Insects. The plates are very numerous, and admired for their peculiar neatness, being engraven in the dot manner, with very considerable delicacy and elegance.

In this year, a most valuable systematic work by Geoffroy was published in Paris, and demands the attention of every entomologist, to whom the possession of it is indispensable. It is entitled, "Histoire Abrégée des Insectes," and divides Insects into six classes, 1. *Coleoptères*; 2. *Hemiptères*; 3. *Tetraptères* à ails nues; 4. *Tetraptères* à ailes farineuses; 5. *Diptères*; and, 6. *Aptères*. In the distribution of the genera, he has made much use of the number of joints composing their tarsi.

L. T. Gronovius published, in 1763, in folio, "Zoophylaceum." Three fasciculi only appeared.

Linnæus again appeared before the public, and produced his "Museum Ludovicæ Ulricæ Reginæ. Holmiæ, 1764." 8vo.

"M. T. Brünnich Entomologia, Hafniæ, 1764." 8vo.

"O. F. Müller Fauna Insectorum Fridrichsdalina, sive Methodica Descriptio Insectorum agri Fridrichsdalensis, &c. Hafniæ et Leipsiæ." 8vo.

Also, J. C. Schæffer's "Abhandlungen von Insecten. 3 Bande. Regenburg." 4to.

And the second part of "Zoophylacium Gronovianum," containing descriptions of about six hundred insects, with synonyms after the Linnean system, accompanied by four illustrative plates. Leyden. Folio.

In 1766, Schæffer published at Regensburg, "Elementa Entomologiæ," containing 132 plates, illustrating the principles of his system; and an additional section with two plates, describing the manner of catching, feeding, and examining insects. He was author of another work on the same subject, entitled, "Zweifel und Schwürigkeiten, welches in der Insectenlehere annoch vorwalten," which was published at Regensburg, but we are ignorant of its date.

Pallas, in 1767, published at Berlin, in 4to, the first fasciculus of his "Spicilegia Zoologica quibus nova informis et obscuræ Animalium species Iconibus, Descriptionibusque atque Commentariis illustratur;" a very valuable work. Several other fasciculi were published before 1780, when the last made its appearance.

In the same year, the twelfth edition of the "Systema Naturæ" of Linnæus was produced; and as it was the last of that celebrated naturalist, we shall lay before our readers his entomological arrangement. He divided insects into seven orders, deducing his characters from their wings, as follow:

Order I. Coleoptera (from κολεος, a sheath, and πτερὸν, a wing). Insects with four wings, the anterior of which are crustaceous, and shut together, forming a longitudinal suture down the back. (*Beetles.*)

Order II. Hemiptera (from ἥμισυ, half, and πτερὸν, a wing). These insects with their upper wings half crustaceous, and half membranaceous, or of a matter intermediate between leather and membrane. (*Bugs, Locusts, Cockroaches.*)

Order III. Lepidoptera (from λεπὶς, a scale, and πτερὸν). Insects having four wings, imbricated with scales. (*Butterflies, Moths.*)

Order IV. Neuroptera (from νεῦρον, a nerve, and

πτερὸν). Insects with four transparent naked wings, reticulated with nerveures. (*Dragonflies, Phryganeæ.*)

Order V. Hymenoptera (from ὑμὴν, a membrane, and πτερὸν). Insects with four naked membranaceous wings. (*Bees, Sawflies.*)

Order VI. Diptera (from δύω, two, and πτερὸν). Insects with two wings. (*Gnats, Flies, Gadflies &c.*)

Order VII. Aptera (from ἀ, without, and πτερὸν). —(*Fleas, Lice, Spiders, Mites, Centipieds, Crabs, &c.*)

The great perspicuity of Linnæus's system of entomology arose from its author having made choice of the most obvious marks which insects afford, for the leading distinctions of his orders. In the construction of his genera, he has taken his characters from the parts of the head alone, especially from the form of the antennæ or horns; these parts being subject not only to a great variety in their appearance, but being also very prominent organs in most insects. That there are other characters, which, in the opinion of modern entomologists, ought not to be neglected, the reader must be perfectly aware; and although these may be too minute for the superficial observer, yet to the man of science, who wishes to study the philosophy of classification, there can rest no doubt as to the superiority of the modern views, which take into consideration every possible character, external as well as internal. The simplicity of the general distribution proposed by Linnæus, the celebrity of his name, and the princely patronage under which he wrote, conspired, with other favourable circumstances, to render the science more universally cultivated, admired, and respected about his time, than it appears to have been at any former period. Much credit is undoubtedly due to this great man for his entomological labours. We must not, however, be so unjust as he was, and neglect to acknowledge the merits of his predecessors, who wrote under less favourable circumstances, but nevertheless excelled in this department of science; and to whom Linnæus stands in a very high degree indebted. In the works of Aristotle and Pliny, in those of Aldrovandus and Swammerdam, as well as in those of our countrymen, Ray, Willoughby, Lister, and various others (whose works we have noticed), we perceive, with some variations, the grand outline on which he has founded his arrangement. It was from these valuable sources that he gained the materials, from which he has selected, with profound judgment, and the greatest success, the valuable matter, carefully and industriously separating the dross. The characters of his orders and genera are to be found in several earlier publications, as are descriptions of many of the species. But he has concentrated these scattered rays of science, with so much skill and industry, that we must admit, that to him the science is indebted for that firm foundation on which it now rests. His style throughout is concise and expressive, but in many instances it is so laconic, that it is impossible even to guess at the animals described.

Bomare published in 1768, " Dictionnaire Raisonné Universel d'Histoire Naturelle, Paris." 4to.

In 1769, in three volumes 4to, " Icones Insectorum Circa Ratisbonam Indigenorum, &c. Regensburg," by Schæffer.

Dr J. Berkenhout published, in the same year, the first edition of his " Outlines of the Natural History of Great Britain." That portion treating of Insects is extremely limited; he has enumerated no more than six hundred species, which are arranged after the Linnean method. Notwithstanding its defects, this little book has materially advanced the study of Entomology in Great Britain.

P. S. Pallas, this year (1770), published his " Spicilegia Zoologica. Berolini." 4to. Eight numbers.

And J. R. Forster published at Warrington, in 8vo, " A Catalogue of British Insects," a mere list of Latin names, amounting to about 1000 species, the greatest number hitherto enumerated. This was intended as a Prodromus to a general work on the Insects of Britain, as we learn from the preface, where the author offers duplicates in exchange for any not in his collection.

D. Drury, also this year, produced a work in one volume, containing descriptions in French and English, with an index of Linnean names, illustrated by coloured copperplates, entitled, " Illustrations of Natural History, wherein are exhibited Figures of Exotic Insects," &c. The plates form a miscellaneous assemblage of the more beautiful exotic insects, which the extensive collection of the author afforded. Three years after the publication of the first volume, a second came out; and the third, which concludes the work, appeared in 1782. Besides those figured and described in the three volumes published, the extensive cabinet of Mr Drury contained many choice specimens, reserved as materials for a fourth, amongst which were a vast number of curious species, collected in the interior of Africa, and other parts of the world rarely visited by Europeans, the introduction of which would have rendered this volume of much greater interest than any of the preceding. Mr Drury's cabinet contained about 11,000 species of insects (in his time the largest collection), which he obtained by transmitting printed directions in various languages for gathering and preserving insects, offering sixpence *per* insect " for all, from the size of a honey-bee upwards." This museum was disposed of by public auction, and produced six hundred pounds. All the British species were purchased by Mr Donovan.

In 1771, John Reinhold Forster produced " Novæ Species Insectorum Centuria," the avowed purpose of which was to describe an hundred species of insects, not mentioned in the latest work of Linnæus. The greater number of these are coleopterous insects, partly indigenous, some from China, and others from South America. These, with the exception of the genera Cistela and Anthribus, which are adopted from Geoffroy, are arranged after the manner of Linnæus. Many of the species were unknown to Linnæus, but some few had previously been made known to the world by the works of Schæffer and Drury. Forster was one of the naturalists who accompanied Captain Cook in his voyage round the world.

The " Mantissa Plantarum" of Linnæ, in which several insects not mentioned in his former works are described, appeared at Holm, this year, in octavo.

In 1772, Curtis produced a translation of the " Fundamenta Entomologiæ" of Linnæ, which tend-

ed materially to advance the study of entomology in this country.

M. T. Brünnich produced his "Zoologiæ Fundamenta, Hafniæ et Lipsiæ," in 8vo.

"Icones rerum Naturalium, &c. par le Professeur Arcanius. Copenhague, 1772." 4to.

Also "Introduction aux Observations sur la Physique, &c. par L'Abbé Rozier." Vol. I. and II. Paris.

This journal, which we shall henceforward term "Journal de Rozier," is now continued monthly under the title of "Journal de Physique." The above two volumes contain, "1. Observations sur le Notopède, par E. Weiss. 2. Histoire des Charansons, avec des moyens pour les détruire, &c. 3. Descriptions des Plusieurs Insectes inconnus jusqu' à ce jour." In this memoir will be found figures of species, considered by the naturalists of the present day as recent discoveries.

In 1773, Kahn published a tract relative to the mode of preserving and catching insects, entitled, "Kurze anleitung Insecten zu sammlen."

In the same year, T. P. Yeats published "Institutions of Entomology," an useful work, being a translation of the characters of Linnean orders and genera, collated with three other systems; namely, those of Geoffroy, Scopoli, and Schæffer. It contains many original observations, but is very defective in the comparison drawn between the systems of Scopoli and Linnæ.

In this year, too, the account of a tour made by the celebrated Russian naturalist Pallas appeared, entitled, "P. S. Pallas Reise durch Verschiedene Provizen des Russichen Reichs, St Petersburgh," which has been translated into Latin and English.

In the same year, Dr J. Hill published a "Decade of curious Insects, some of them not described before, shown of their natural size, and as they appeared through a microscope," &c. which is illustrated with ten quarto plates, in which the figures are sometimes immensely magnified, and far from correct. The accounts are in English, and are accompanied with observations on their economy.

In 1774 was published at Amsterdam, in folio, by Jacob L'Admiral, "Veranderingen van Veele Insecten."

And "J. L. Tagebuch der Reise durch verschiedene Provinzen der Russischen Reichs, Alenburgh." Two other volumes were published before 1783.

The Journal de Rozier, for this year, contains, 1. "Observations sur les Mouches communes, par Blondeau. 2. Mémoire sur la manière d'elever les larves des Papillons, &c. par M. Nicolas. 3. Lettre de M. Bonnet, sur les moyens de conservir diverses espèces d'Insectes," &c.

In 1775, J. C. Fabricius, a pupil of Linnæus, published a new system of Entomology, under the title "Systema Entomologiæ," in which the principles of a new mode of classification are, for the first time, developed. He has taken the essential characters of his classes and genera, from the parts of the mouth (Instrumenta Cibaria), which has given to his classification the title of *Cibarian System*. In this work, he has disposed all Entoma into eight classes, viz. *Eleutherata*, *Ulonata*, *Synistata*, *Agonata*, *Ugonata*, *Glossata*, *Rhyngota*, and *Antliata*. In this general arrangement Fabricius has been followed by but few; but his mode of distinguishing the genera it still retained by all; and by the followers of Latreille, it is combined with other essential characters, such as organs of locomotion, &c. He gained so much reputation by this work, that he prosecuted his labours with increased ardour, and acquired the rank of the first entomologist of his age. We shall notice his later system in proper order.

Also, "Descriptiones Animalium, &c.; quæ in Itinere Orientali observavit, Petrus Forskal. Post mortem auctoris, edidit Carsten Niebuhr."

Moses Harris also published a little pamphlet, entitled, "The English Lepidoptera, or Aurelian's Pocket Companion," &c. London; an alphabetical catalogue of the larger Lepidoptera, collected by its author in England. This little tract, although apparently insignificant, has materially contributed to the practical study of entomology in Britain. The Linnean names, as far as they were known to him, were added, and the time and place of the appearance of the insects in their different states are concisely given in columns. A frontispiece is added, explaining the terms used in the description of the insects of this order.

"Dissertazione seconda su de' Timpanetti dell' udito scoverti Nel Granchio Paguro e Sulla Bizzarra di lui vita, del P. A. Minasi. Napoli, 1775." 8vo. We received this rare work as we were correcting the press; it is therefore impossible to give an analysis of its contents.

The Journal de Rozier, for this year (Vol. V. and VI.), contains, "Trois Mémoirs sur les Abeilles," &c. par M. Bonnet; and Vol. VIII., for 1776, contains, "Essai sur la Fourmi, par M. Barboteau."

In the same year, Peter Brown, in his "New Illustrations of Zoology," figured several insects.

And J. H. Sulzer published, in quarto, his "Abgekürzte Geschichte der Insecten, Winterthur."

The "Genera Insectorum" of Fabricius appeared in this year.

Also, "Beytrage zur Naturgeschichte von Franz, von Paula Schrank, Leipzig." 8vo.

O. F. Müller produced his "Zoologiæ Danicæ Prodromus, &c. Hafniæ," which is an useful book.

A valuable work was published at Halle in octavo, by J. Schröter, named, "Abhandlungen über verschiedene Gegenstande der Naturgeschichte;" a succeeding part appeared in 1777.

Also, an useful book in quarto, entitled, "Systematisches Verseichniz der Schmetterlinge der Wienergegand, &c. Wien."

Scopoli, in 1777, produced his "Introductio ad Historiam Naturalem." In this work, insects are divided into five groups, under the singular appellations of, 1. *Swammerdami-lucifuga*; 2. *Geoffroy-gymnoptera*; 3. *Roëselii-lepidoptera*; 4. *Reaumurii-proboscidea*; 5. *Frischii-coleoptera*. In this manner he identifies each tribe with the name of the author who has, in his opinion, been most successful in the explanation of that to which his name is attached.

In this fertile year, J. A. E. Goeze began his extensive systematic work, called, "Entomologische beyträge zu des Ritters Linné zwöfften Ausgabe

des Natur Systems," &c. which was continued progressively in parts, till 1783, in octavo.

Esper also produced in Germany the first part of his valuable work on Lepidoptera, entitled, "Die Schmetterlinge in Abbildang nach der Natur mit Beschreibungen," illustrated by several plates; a second part appeared in 1779, and, before 1786, two other parts also were published.

The Journal de Rozier, for this year (Vols. IX. and X.), contains, 1. "Suite de l'Essai sur la Fourmi, par M. Barboteau. 2. Description d'une Lepture, et d'une espèce de Scorpion aquatique;" and Vol. XI., for 1778, contains, "Observations sur la production des pattes des Crabes, par M. de Badier."

At Berlin, during the same year, P. S. Pallas published in quarto, "Naturgeschichte Merkwürdigen Thiere, in welcher Vornehmlich neue und unbehannte Thierarten durch kupferstriche, Beschreibungen und Erklärungen erläutert werden."

And, Paul Czempinsky, in octavo, "Totius Regni Animalus Genera."

Also, in quarto, "Nomenclatur und Beschreibung der Insecten in der Graffschaft Hanau-Münzenberg, von J. A. B. Bergstræsser."

"Magazin für die Liebhaber der Entomologie Heramsgegeben, von J. G. Fuesly, Zurich und Winterthur."

"Versuch einer Naturgeschichte vom Livland, Entworfen, von J. L. Fischer, Leipzig." 8vo.

Moses Harris also published his "Aurelian, or Natural History of English Insects, namely, Moths and Butterflies, London." 4to.

Lastly, "J. C. Fabricii Philosophia Entomologica;" a small work, which, with all its faults, is indispensably necessary to the library of the scientific Entomologist.

In 1779, Pieter Crammer published a work on exotic Lepidoptera, entitled, "De vit Landsche Kapellen, Voorkomende in de drie Waereld deelen Asia, Africa, en America." This part, with the continuation published in 1782, consists of four quarto volumes.

And, in the same year, another very extensive work, devoted also to Lepidoptera, named, "Papillons, d'Europe peints d'après Nature, par Ernst."

Also, in octavo, "Anfangsgründe der Naturgeschichte, von N. G. Leske. Leipzig."

The Journal de Rozier, for this year, Vol. XIII., contains, "Observations sur les Œufs des Papillons, par J. Bernoulli."

A very valuable little book, in one volume octavo, on the animals of Greenland, was published in 1780, viz. "Othonis Fabricii Fauna Grœnlandica. Hafniæ et Lipsiæ."

"Lettres sur les Truffes du Piémont," par le Comte de Borch. Milan, 1780. 8vo. Contains Observations on the insects that destroy truffles.

"Hydrarchnæ quas in aquis Dariæ palustribus detexit, descripsit, &c. Otho Fredericus Müller. Lipsiæ, 1781." A very valuable work, with good figures of the species of the genera Hydrachna, and Elaïs.

"J. C. Fabricii Species Insectorum, Hamburgi et Killonii." Two volumes octavo.

F. P. Schrank produced a descriptive catalogue of the Insects of Austria, called, "Enumeratio Insectorum Austriæ Indigenorum," which has since been rendered into German by Fuesly.

Johann Nepomuk von Laicharting, in this year, published at Zurich, the first part of his catalogue of the Insects of the Tyrol, "Verzeichniss und Beschreibung der Tyroler Insecten;" a second part appeared in 1784. He adopts a system very distinct from that of Linnæus. Insects are by him disposed into ten groups, characterized from various parts of the body, and are named, *Scarabæoïdes*, *Grylloïdes*, *Cimicoïdes*, *Papilionoïdes*, *Libelluloïdes*, *Vespoïdes*, *Muscoïdes*, *Cancroides*, *Aranoïdes*, and *Oniscoïdes*.

"Icones Insectorum præsertim Rossiæ, Siberiæque, peculiarium, quæ collegit et descriptionibus illustravit, Petrus Simon Pallas, M.D. Erlangiæ, 1781." One volume 8vo.

Thunberg, too, published at Upsal, the first part of his "Museum Naturalium Academiæ Upsalensis," to which twenty other parts, and an appendix, were added before 1800.

"Beitrage zur Insektengeschichte, &c. W. Knoch, Leipzig." 8vo.

James Barbut published, in the same year, an elementary book, entitled, "The Genera Insectorum of Linnæus, exemplified by various Specimens of English Insects," London. As an illustration of the Linnean System, this work may not be uninteresting to the English reader, but his views are too limited to admit of even mere general utility. Its author does not seem to have been aware of the vast improvements the science had undergone on the Continent, in the interval between the publication of Linnæus's last work, and the time he wrote; and has, therefore, drawn no comparisons between them, which, without innovation, must have placed the science in a more lucid point of view. It is to the silence of English writers, either arising from want of information, from sentiments of illiberality, from jealousy or negligence, that we must ascribe the very low state of entomological (and indeed of every branch of zoological and zootomical) knowledge in Britain, at the present period.

Moses Harris, in 1782, published his "Exposition of English Insects, &c." illustrated by fifty-one copperplates, in 4to, in which he has given figures of about 500 species. The descriptions are in French and English; the specific names in Latin, but many of them of a nature by no means to be tolerated, such as *Apis Audeo*, &c.

In the Transactions of the French Academy we find a paper by Morand, entitled, "Memoire sur les Vers de Truffes, et sur les Mouches qui en proviennent."

"Versuch eines Diarium über die Œconomie Mancher Insecten im Winter, von J. S. Semler."

Another interesting work appeared this year, "Nues Magazin für die Liebhaber der Entomologie, Herausgegeben, von J. C. Fuesly, Winderthur." 8vo.

In 1783 appeared "C. Lib. Bar. De Geer. Genera et Species Insectorum e generosissimi auctoris scriptis extraxit, A. J. Retzius. Lipsiæ, 1783." 8vo. In this work, insects are divided into fourteen groups, under the titles, *Lepidoptera*, *Alinguia*, *Neuroptera*, *Hymenoptera*, *Syphonata*, *Dermoptera*, *Hemiptera*,

Coleoptera, Halterata, Proboscidea, Suctoria, Arcenata, Atrichelia, and *Crustacea.*

In the same year, W. Curtis published an interesting little pamphlet, " A Short History of the Brown-Tail Moth," the caterpillar of which had appeared in such immense swarms in the fields surrounding London, during the summer of 1782, and despoiled so many trees of their foliage, as to create apprehensions of the total destruction of the whole vegetable kingdom, and to spread such an alarm throughout the whole population of that vast metropolis, that prayers were ordered to be read in all the churches to avert the supposed impending calamity. The object of this tract is to point out the absurdity of these apprehensions, and to show, that corn and grass, not being the food of these voracious animals, would escape their attack.

In 1784, J. A. B. Bergstræsser published his elementary work, in octavo, entitled, Entomologia Scolarum in usu Concinnata."

Thunberg, in this year, published his " Dissertatio sistens Insecta Suecica."

And Herbst produced his work, entitled, " Kurze Einleitung zur Kenntniss der Insecten, Berlin." 8vo.

The "Journal de Rozier" (Vols. XXIV. and XXV.) contains, 1. " Mémoire sur l'Histoire des Abeilles, par l'Abbé Ray." 2. " Dissertation sur la sensibilité des Insectes, précédée de quelques observations sur la Mante, par l'Abbé Poiret;" and Vols. XXVI. and XXVII., for 1785, contain, 1. " Moyen simple de dessécher les larves pour les conserver dans les collections Entomologiques à côté des Insectes qu'elles produisent, par D'Antic." 2. " Description de quelques individus monstrueux de la Pédiculaire des Bois, par Reynier."

" Entomologia Parisiensis, sive Catalogus Insectorum quæ in agro Parisiensi reperiuntur, secundum Methodum Geoffrœanum, edente A. F. De Fourcroy." Two volumes 12mo.

Matthew Martyn published this year in Exeter, his " Aurelian's Vade Mecum." The insects are whimsically arranged, according to the Linnean classes and orders of plants on which they feed.

" Historia naturalis Curculionum Sueciæ, auctore Gabriel Bonsdorff, &c. Upsaliæ." 4to.

" Natursystem aller Bekanten in und Auslandischen Insecten, &c. von Carl. Gustaf. Jablonsky, Berlin, Fortgesetzt, von J. T. W. Herbst."

In 1786, Xavier Wulfen published an account of the Insects inhabiting the Cape of Good Hope, entitled, " Descriptiones quorandam Capensium Insectorum, Erlangæ."

The " Journal de Rozier," for this year (Vols. XXVIII. and XXIX.), contains, 1. " Observations sur des Crevettes de Rivière phosphoriques, par MM. Thulis et Bernard." 2. " Recherches sur les Sauterelles et sur les moyens de les détruire, par M. Baron;" and Vols. XXX. and XXXI., for 1787, contain, 1. " Observations sur la durée de la vie de certains Insectes, par M. Riboud." 2. " Mémoires sur quelques Insectes de Barbarie, par l'Abbé Poiret." 3. " Observations sur les effets de la figûre de l'Araignée-Crabe des Antilles, par M. Arthaud." 4. " Description de la Bête à mille pieds de St Domingue, par le même." 5. " Lettre de M. Bruyère, à M. Thouin, sur un nouvel Insect." 6. " Mémoire sur quelques Insectes, par M. de la Martinière." 7. " Lettre de le Comte de Razoumousky, sur une Araignée."

" Dominicus Cyrillus published this year a folio work on the Insects of Naples, entitled, " Entomologia Neopolitana."

A curious little tract, on the Gad-fly, was published in Leipsic, by J. S. Fischer, entitled, " Observationes de Œstro ovino atque bovino factæ."

" J. C. Fabricii Mantissa Insectorum, Hafniæ." Two volumes 8vo.

" V. Petagnæ Specimen Insectorum Ulterioris Calabriæ, Francofurti et Moguntiæ." 4to.

" Disputatio inauguralis de Coccinellæ Natura, Viribus et Usu, A. J. G. Linck. Lipsiæ." 4to.

John Adams published " Essays on the Microscope," in quarto, London.

The " Journal de Rozier," Vol. XXXIII., for 1788, contains, 1. " Extrait d'un Mémoire lu à l'Académie des Sciences, sur les parties de la bouche des Insectes, par M. Olivier;" and Vols. XXXIV. and XXXV., for 1789, contain, 1. " Recherches sur la Chenille Processionaire du Pin, par M. Dorthes." 2. " Mémoire sur quelques espèce de Charansons de la Guyenne Françoise, par M. Sonini de Monoucour."

A series of Letters, on the important subject of the cochineal insect (which had been discovered at Madras a few years before), from James Anderson, addressed to Sir J. Banks, from Madras, were published. Two other letters have been published since.

In the same year, Swederus published a monograph on that curious and interesting genus *Cerapterus,* in a Memoir, entitled, " Beskrifuing poa elt nytt genus ibland insecterna, hörande til Coleoptera."

The work of M. B. Borkhausen, on the Lepidoptera of Europe, appeared at Francfort, entitled, " Naturgeschichte der Europaischen Schmetterlinge nach Systematischer ordnung."

J. F. Gmelin published his edition of the Linnean *Systema Naturæ.* The Entomological part is comprized in three parts, and was published at Leipsic. The editor is considerably indebted to the writings of Fabricius; and, although he rejects his classification, yet he has copied the species, and incorporated them with the Linnean genera, which he has divided into families, answering to the Fabrician genera, and has, by this means, very materially augmented and improved the original work of Linnæus; although he has committed a vast number of the most inexcusable blunders, especially in his quotations and references to plates. He has, in many instances, described the same species twice or three times, under different names. But we are surprised that his errors are so few, when we consider that he was but a closet compiler.

In this year also was published, in Leipsic, a work, entitled, " Nützliches Allerley aus der Natur und dem gemeinen Leben für allerley Leser, von J A. E. Goeze." 8vo.

Mr Thomas Marsham wrote the article Entomo-

logy in "Hall's Encyclopædia," which is illustrated by three plates. In this paper he briefly explains the Entomological System of Linnæus, and mentions the names of several authors of eminence; he likewise explains the method of collecting and preserving insects.

In this year, too, J. J. Römer published his "Genera Insectorum Linnæi et Fabricii, Iconibus Illustrata, &c. Vitaduri Helvetiorum." 4to. This work contains thirty-seven explanatory plates, nearly all of which had previously constituted the work of Sulzer.

The celebrated Olivier published this year the first part of a very voluminous and valuable work, entitled, "Entomologie, ou Histoire Naturelle des Insectes, avec des caractères génériques et specifiques, &c. Paris." 4to. From its title, it would seem that the author intended to have treated on every class and order; and, in conformity with the first part, to have illustrated the whole with figures. He, however, has confined the book entirely to the illustration of the Coleoptera, which was rendered as complete as possible, and as a work of reference, is one of very great utility.

G. Paykull produced in this year, at Upsal, "Monographia Staphylinorum Sueciæ," in octavo.

And C. de Villers published, at Lyons, a small work, under the title, "Linnæi Entomologia, &c. curante et augeate C. de Villers, Lugduni," 8vo. In which the author has availed himself of the works of Scopoli, Geoffroy, De Geer, and Fabricius.

And at Leipsic, in octavo, "Anfangsgründe der Naturgeschichte von N. G. Leske."

In 1790, some remarks on the genus Melolontha were published in the "Journal fur die Entomologie," &c. vor D. J. Mayer.

In the same year, a catalogue of the Insects of Bohemia, entitled, "J. D. Preysler, Verzeichniss Böhmischer Insecten, Prag." 4to.

And "Fauna Estruca, sistens Insecta, quæ in provinciis Florentina et Pisana præsertim collegit, Petrus Rossius, Liburni." 4to. The genus *Xenos*, the type of the new order *Rhipiptera*, is first made known in this work.

Also, "Dissertatio Historico-naturalis, ignotas Insectorum species continens; auctore Conrad Quesnal, Lundæ." 4to. This author is also the author of two tracts, but we are ignorant of their dates; the first is on Papilio, entitled, "Beskrifningar öfer 8 nya Svenska, Dagfjarillar;" the second on a moth, "Beskrifningar öfer en y Nattjaril."

G. Paykul too produced his "Monographia Caraborum Sueciæ."

L. G. Scriba likewise published two works, "Beytrage zu der Insecten Geschichte; Frankfurt." And "Journal für die Liebhaber der Entomologie; Frankfurt."

And "Insecten Kalender, von N. J. B. Mainz." 8vo.

The Journal de Rozier, Vol. XXXVI., contains a paper entitled, "Notice sur un phénomène occasioné par une espece de Fourmi nommée par Linnæus *Formica* nigra; par M. Dorthes."

Lastly, the first volume of a great compilation on Zoology, entitled, "Vivarium Naturæ, or the naturalist's Miscellany, by G. Shaw, the figures by P. Nodder." A volume was produced annually for twenty-four years, when the author died. Several gaudy insects are figured in this work.

In 1791, the first volume of the "Transactions of the Linnean Society of London" appeared, and contained the following papers: 1. "On the *Phalæna Bombyce Lubricepeda* of Linnæus, and some other species allied to it; by T. Marsham, Esq." 2. "Some observations on the Natural History of *Curculio Lapathi* and *Silpha grisea* of Linnæus; by W. Curtis, Esq." 3. "Account of a singular conformation in the Wings of some Moths, by Esprit Giorna." 4. "Descriptions of two new species of *Phalæna*, by L. Bosc;" and, lastly, under the head of extracts from the minute book, we find mention of a new Baprestis, communicated by Mr Dryander.

In the same year, "Neuestes Magazin für die Leibhaber der Entomologie, herensgegeben von D. H. Schneider; 5 hefte. Straulsund." 8vo.

Likewise, "Alphabetisches Verzeichnis der Bischer Behaunten Schmeterlinge, &c. Von C. C. Jung. Marktbreit." 8vo.

Also, an interesting work on some Hymenoptera, entitled, "Naturgeschichte, Klassification und Nomenclatur der Insecten von Beinen, Wesgen und Ameisengeschlet. Frankfort am Main; von C. J. Ludwig." 4to.

In 1792, Edward Donovan published the first volume of his "Natural History of British Insects." 8vo. The work consists of eighteen volumes, which were published in successive years, and includes figures and descriptions of a considerable variety of species, being the most extensive elucidation of British Entomology that has hitherto been undertaken.

Thomas Martyn published in the same year, "The English Entomologist, exhibiting all the coleopterous insects found in England, including upwards of five hundred different species, the figures of which have never been given to the public; the whole accurately drawn and painted after nature, arranged and named after the Linnean system. London." 4to. Although this work is so frequently cited, the figures are nearly useless, and the text but indifferent.

J. C. Fabricius published in this year his "Entomologia Systematica." A supplement appeared in 1798, under which date we shall mention his latest systematic views.

And G. Paykull produced his "Monographia Curculionum Sueciæ."

Lastly, O. F. Müller published his celebrated work, "Entomostraca seu Insecta testacea quæ in aquis Daniæ et Norvegiæ reperit, descripsit et Iconibus illustravit, O. F. Müller. Frankfurti." 4to. In this volume, all the Entromostraca, which Linné had comprehended under the generic title *Monosculus* (excepting his cancer *salinus* and *stagnalis*), are arranged as follow:

I. Monoculi. * *Univalves.* Gen. 1. Amynome; 2. Nauplius.
** *Bivalves.* Gen. 3. Cypris; 4. Cythere; 5. Daphnia.
*** *Crustacei.* Gen. 6. Cyclops; 7. Polyphemus.

II. Binoculi. * *Univalves.* Gen. 8. Argulus; 9. Caligus; 10. Limulus.
** *Bivalves.* Gen. 11. Lynceus.

G. W. F. Panzer, in 1793, published his "Beyträge zur Geschichte der Insecten. Erlang.;" and, in the same year, commenced the "Fauna Insectorum Germaniæ Initia, oder Deutchland Insecten." One hundred and nine numbers, each containing twenty-four plates, were published before the death of the author. In the following year, 1794, he published his "Entomologia Germanica. Pars I. Nuremberg." 8vo. Also "Fanunæ Insectorum Americæ Borealis Prodromus;" and edited "J. E. Voet Icones Insectorum Coleoptratorum, &c. illustravit G. W. F. Panzer. Erlangæ." 4to.

"Neuestes Magazine für die Libhaber des Entomologie herausgegeben, von D. H. Schneider. Stralsund." 8vo.

A second volume of the Transactions of the Linnean Society appeared this year; in which are the following Entomological papers: 1. "The History and Descriptions of four species of *Phalæna*, by Mr J. Beckwith." 2. "A new arrangement of the genus Papilio of Linnæus, by W. Jones." In this paper a new division, the *Romani*, is added, and the characters of the Linnean divisions are very much amended.

In the Journal de Rozier (which here, for the first time, appears under the care of J. C. Lamétherie), for this year, we find a paper by Monsieur Luce, entitled, "Description d'un Insecte-Phosphorique."

In 1795 was published in Halle, in 8vo, "Entomologisches Bilderbuch für junge Insectensamler, von J. H. A. Dunker."

"D. H. Hoppe Enumeratio Insectorum circa Erlangani indigenorum, &c.; Observationibus Iconibusque illustrata, Erlangæ." 8vo.

"The Papilios of Great Britain, by W. Lewin. London." 4to. In this work the Butterflies of England, sixty in number, and all that were at that time discovered in England, are elegantly figured.

The "Gesellschaft Naturforschender Freunde zu Berlin," for this year, contains a paper entitled "Bescreibung einiger ostindischen Insectin, von Missionarius John in Tankebar."

P. A. Latreille, in 1796, produced his "Precis du caractéres des Genres," a work which commences a new æra in the science of Entomology, and in which, for the first time, the distribution of Insects, Crustacea, &c. into families, is indicated. The genera are characterized by the modification of the organs of mastication. Throughout this volume we find the same acuteness of observation, that characterizes all the works of this, the first of Entomologists.

Mr John Francillon also published this year, "Description of a rare Scarabæus, from Potosi." The subject of this paper has been named *S. Macropus*, by Shaw. It forms the type of a new genus, the characters of which will be soon given to the world, by W. Macleay, Esq. a most accurate and learned entomologist, who is now occupied with examining the old genus Scarabæus of Linnæus, of which his father's cabinet contains about 2000 species, which he intends to arrange into natural families and genera.

The second volume of "Catalogus Bibliothecæ Historica Naturalis, Josephi Banks, Baroneti," by T. Dryander, comprehending the entomological works of that immense collection, appeared this year. The contents of this work are so admirably arranged, as to form a valuable bibliographical system of Entomological writers, down to the day of its publication.

"Monographia Bombyliorum Bohemiæ, Iconibus Illustrata, auctore J. C. Mikau, M. D. Pragæ."

In 1797 appeared, "Natursystem der Ungeflügelten Insecten, von J. F. W. Herbst. Erster Heft. Berlin." 4to. This volume contains the *Solpugæ*, *Phrynni*, *Thelephroni*, and *Opiliones*, which are illustrated by coloured figures.

"Illustratio Iconographia Insectorum quæ in Musæis Parisnis observavit, J. C. Fabricius. Auctore S. J. Coquebert." 4to.

"Mantissa Insectorum Iconibus Illustrata, &c. Fas. 1. auctore G. C. Reich, Norimbergæ." 8vo.

"The Natural History of the rarer Lepidopterous Insects of Georgia, collected from the Observations of M. J. Abbot, by J. E. Smith, M. D." This work is comprised in two volumes, with about an hundred plates, copied from the original designs made from nature by Mr Abbot, to whom the London collectors of insects are indebted for the greater portion of the Georgian insects contained in their cabinets. Eighteen volumes of insects, their larvæ, &c. and spiders, drawn by Mr Abbot, are now deposited in the British Museum, for the use of those engaged in the study of entomology.

The third volume of the "Transactions of the Linnean Society of London," containing some interesting papers, appeared in the same year. 1. "Observations on some rare Insects, by W. Lewin." 2. "History of three species of *Cassida*, by the Rev. W. Kirkby." 3. "Observations on the Economy of *Ichneumon Manifestator*, by T. Marsham, Esq." 4. "Observations on the Insects that infested the Corn in 1795, by the same." 5. A most interesting and valuable paper on "The *Œstrus* or *Gadfly*, by B. Clark, Esq."

In 1798, J. C. Fabricius published the supplement to his "Entomologia Systematica;" which presents to us his system in its latest state, and therefore deserves to be recorded here.

Class I. Eleutherata. Jaws naked, free, bearing palpi.

Class II. Ulonata: Jaws covered with an obtuse mouth-piece or galea.

Class III. Synistata. Jaws elbowed near the base, and connected to the lower lip.

Class IV. Piezata. Jaws horny, compressed, and generally elongated.

Class V. Odonata. Jaws horny and toothed; two palpi.

Class VI. Mitosata. Jaws horny, arched; no palpi.

Class VII. Unogata. Jaws horny, unguiculated.

Class VIII. Polygonata. Jaws many, within the lip.

Class IX. Kleistagnata. Jaws many, without the lip.

Class X. Exognata. Jaws many, outside the lip covered by the palpi.

Class XI. Glossata. Mouth with a spiral tongue between the palpi.

Class XII. Ryngota. Mouth composed of a beak, or articulated sheath.

Class XIII. Antliata. Mouth composed of a sucker.

The first of these classes contains the order *Coleoptera;* the second, the orders *Orthoptera, Dermaptera,* and *Dictyoptera;* the third, the orders *Thysanura, Trichoptera,* and a part of the *Neuroptera;* the fourth, the order *Hymenoptera;* the fifth, the *Neuroptera;* the sixth, the class *Myriapoda;* the seventh, the class *Arachnoïda;* the eighth, ninth, and tenth, the class *Crustacea;* the eleventh, the order *Lepidoptera;* the twelfth, the orders *Hemiptera* and *Omoptera;* the thirteenth, the order *Diptera.* This system was followed by a very few entomologists, and is now entirely set aside.

In the same year, Clairville published an excellent work on the insects of Switzerland, entitled "Entomologie Helvetique," in which he has distributed them into the following orders: viz.

I. Peterophora. With wings.

A. Mandibulata. With jaws.

Section 1. *Elythroptera.* Wings crustaceous.
——— 2. *Deratoptera.* Wings coriaceous.
——— 3. *Dictyoptera.* Wings reticulated.
——— 4. *Phleboptera.* Wings veined.

B. Haustellata. With a sucker.

Section 5. *Halteriptera.* Wings with a balance.
——— 6. *Lepidoptera.* Wings covered with powder.
——— 7. *Hemimeroptera.* Wings half obscure, half diaphanous.

II. Aptera. Without wings.

A. Haustellata. With a sucker.

Section 8. *Rophoteira.* With a sharp rostrum.

B. Mandibulata. With jaws.

Section 9. *Pododonera.* Runners.

This first volume treats of the *Curculionidæ,* and is illustrated by some very beautiful plates. Volume second appeared in 1806, and contains the *Carabidæ* and *Dyticidæ.* Both are highly interesting, and are very necessary to the library of an European Entomologist.

"Verzeichniss der Käfer Preussens, &c. von J. K. W. Illiger, Halle, 1798." 8vo. This highly interesting work contains the most accurate descriptions of the Prussian insects, and should find a place in every entomological library.

"Philosophie Entomologique, &c. pour servir d'introduction à la Connoissance des Insectes, &c. par J. F. Saint-Amans, &c. Agen, an. vii." 8vo. It contains descriptions of the parts which compose an insect, and terminates with an exposition of the methodical distribution of insects by Geoffroy and Linné, combined with that of Fabricius.

"Lepidoptera Pedimontana illustrata a Leonardo de Prunner. Augusta Taurinorum." 8vo.

"Naturgeschichte der schädlichen Nadelholz-Insecten, nebst Anweisung zu ihrer Vertilgung, &c. von G. G. Zinke, Weimer." 8vo.

Voigt, in this very fertile year, published his "Magazin für den neuesten Zustand der Naturkunde mit Büschricht auf die dazu gehörigen Hülfwissenschaften, von J. H. Voigt. Weimer." 8vo.

Entomology.

Schrank also published his "Fauna Boica, &c. Nurnberg." 8vo.

And, in the same year, Paykull published his "Fauna Suecica, Insecta, Upsaliæ," in three octavo volumes.

"M. C. G. Lehmann de Sensibus externis Animalium exsanguinium Insectorum scilicet ac Vermium, &c. Gottingæ." 4to.

"Faunæ Ingricæ Prodromus, exhibens Methodicam descriptionem Insectorum agri Petropolensis, &c. auctore J. Cederheilm, Leipsiæ."

E. Donovan, this year, published in London, "Natural History of the Insects of China," which was the first work that has appeared on the insects of that vast empire. The materials composing this volume (which is in quarto), and from which it was in a great manner formed, were obtained from the first and most authentic sources, including many of the species collected at the time of the embassy of Lord Macartney. This work is illustrated with fifty copperplates, beautifully executed.

In the fourth volume of the "Linnean Transactions," we find, "An Essay on the Eye-like Spot in the Wings of the Locustæ of Fabricius, as indicating the male sex, by Professor A. A. H. Lichtenstein."—"Account and figure of a minute Ichneumon, by G. Shaw, M. D."—"*Amophila,* a new genus of Hymenopterous Insects, including the *Sphex sabulosa* of Linné, by the Reverend W. Kirby."—"Farther observations on the *Wheat Insect,* &c. by T. Marsham, Esq."—"History of Tipula Tritici, and *Ichneumon Tipulæ,* &c. by the Reverend W. Kirby."—"Observations on the genus Pausus, and descriptions of a new species, by A. Afzelius, M. D."

The "Journal de Physique for 1798" (Vols. III. and IV.) contains, 1. "Observations sur les Œstres, par B. Clark."—"Sur les Araignées tendeuses, communiquée par P——;" and Vol. LI. for 1799 (An. IV.) contains, "Exposition d'une Méthode Naturelle pour la Classification des Insectes, par le Citoien Duméril."

Few other works appeared in this year. Amongst them are,

"Entomologische Versuche von C. Crutzer. Wien, 1799." 8vo.

"Europäischen Fauna oder Naturgeschichte der Europäischen Thiere. Von J. A. E. Goeze. Kæfer, Leipzic." 8vo.

"Natural History of the Slug-worm. By W. D. Peck. Boston." 8vo.

"Mémoires pour servir à commencer l'histoire des Araignées Aquatiques. Par J. F. A. O."

In 1800, Cuvier, with the assistance of Duméril, published, in Paris, his "Leçons d'Anatomie Comparée," in which the anatomy of Insects is treated of at great length, and a new systematic arrangement is proposed, in which Insects are divided into those with jaws, such as *Grathaptères, Neuroptères, Hymenoptères, Coleoptères,* and *Othoptères;* and, secondly, into those that want jaws, *Hemiptères, Lepidoptères, Diptères,* and *Aptères.*

"Nouvelle Classification des Mouches a deux ailes, &c. par J. G. Meigen. Paris." 8vo. This is

the first production of a man who has enriched the classification of Diptera, not only by describing new species, but by laying the groundwork for their classification. He has in this work characterized eighty-eight genera, and, at the end of each, has enumerated the species. Many of the names proposed have been since changed by Illiger.

" Icones Cimicum descriptionibus illustratæ. Dec. 1. Auctore J. F. Wolff. Erlangæ." 4to. The second fascicule appeared in 1801.

" Cimicum in Helvetiæ aquis et terris degentium genus in familias redactum, &c. a J. R. Schellenberg. Turici." 8vo. This tract is illustrated by figures of the genera.

" G. Payhull, Fauna Suecica. Insecta. Tom. III. Upsaliæ." 8vo.

" Natursystem der Ungeflügelten Insekten, von J. F. W. Herbst. Viertes Heft. Berlin." 4to. This number contains a monograph on Scorpio, with coloured figures.

E. Donovan published in this year his " Insects of India," embracing in a general, yet scientific view, a comprehensive display of the most rare and beautiful insects peculiar to these fertile regions.

" Archiv für Zoologie und Zootomie. Von C. R. W. Wiedmann. Berlin und Braunschweig." In four volumes 8vo.

" Verzeichniss meiner Insecten Samlung oder Entomologisches Handbuch für Liebhaber und Samler. Von J. Sturm, Erst Heft. Nurnberg." 8vo.

Thunberg produced his " Museum Naturalium Academiæ Upsalensis," &c. 4to.

Lastly, the fifth volume of the " Bibliotheca Hist. Nat. Banksiana," by J. Dryander, containing several very valuable and numerous references to the works of Entomological writers.

Lamarck, in 1801, published his celebrated " Systême des Animaux sans Vertébres," in which we find considerable advances in Entomological arrangement. The greater portion of the Linnean *Aptera* he has placed in the classes *Crustacea*, and his new class *Arachnides*. The Insecta he divides into, I. With mandibles and maxillæ, Order 1. *Coleoptères ; 2. Orthoptères ; 3. Neuroptères*. II. With mandibles and trunk, Order 4. *Hymenoptères*. III. With a trunk or sucker ; no mandibles ; Order 5. *Lepidoptères ; 6. Hemiptères ; 7. Dipteres ; 8. Aptères*.

" J. C. Fabricii Systema Eleutheratorum, &c. Kiliæ." Two volumes 8vo.

" Natursystem aller bekannter inund auländischen Insecten, &c. Von J. F. W. Herbst. Der Käfer neunter Theil. Berlin."

" Beiträge zur Insectenhunde, &c. Von A. W. Knoch. Erster Theil. Leipzig." In this work the author has described with the greatest accuracy several new genera and species of Insects, which are illustrated by some excellent coloured figures.

" D. Lehmann de Antennis Insectorum."

" F. Weberi Observationes Entomologicæ, &c. Kiliæ." 8vo.

" Illustratio Iconographica Insectorum, &c. Auctore A. J. Coquebert. Tab. Decas II. Parisiis. An. x." 4to.

" Systematisches Verzeichniss, von der Schmitterlingen, &c. Von Lehrern. Zweiter Band. Braunschweig." 8vo.

" Kleiner Beytrag zur Entomologie, &c. Von P. Frost. Erster Heft. Erlangen." 8vo.

" Der Gesellschaft Naturforschender Freunde zu Berlin. Dritten Band, Berlin," for this year, contains, " Zu einer neuen gattung Sceliphon. Darch Herrn Dr Klug."

" Sesiæ Europæ, &c. Auctore J. H. Laspeyres. Berolini." This work is illustrated by some very neat figures of the species.

Illiger's Magazin for this year contains, 1. " Nachtrag and Berichtigungen zum Verzeichnisse der Käfer Peussens." 2. Namen der Insehten-gattungen."

" J. Sturm's Abbildungen zu Karl Illiger's Ueberfetzung. Von Olivier's Entomologïe, &c. Narberg." 4to.

" Magazin für Insektenkunde, von K. Illiger. Ersten Bandes. Braunschweig." 8vo. Containing, 1. " Nachtrag und Berichtigungen zum Verzeichnisse der Käfer Preussens." 2. " Ist es richtiger, genus durch Geslecht oder durch Gattung auszudrükken ?" 4. " Namen der Insekten-Gattungen, ihr Genitiv, ihr grammatisches Geschlecht," &c. 5. " Die Deutschen Namen der Insektengattungen." 6. " Neue Insekten." 7. " Ueber der Winteraufenthalt der Käfer, vom H. Schmid." 8. " Bemerkungen über *Lygæus apterus*, von F. Hausmann." The same work, for 1802, contains, 11. " Ueber das Fabricische System," &c. 12. " Aufzählung der Käfergattungen nach der Zahl der Trussglieder." 13. " Zusatze, Berichtigungen und Bemerkungen zu Fabricii Systema Eleuteratorum." 14. " Beiträge zu den Materialien einer künftingen Bearbeitung der Gattung Blattläuse, von F. Hausmann." 15. " Bemerkungen über die Europäischen Arten der vierzehnten Familie der Schmetterlinge im 10ten Bande von Herbst's Natursystem, &c. Von J. C. Grafen von Hoffmansegg." 16. " Beschreibung eines neuen Werkzengs zum Insectenfange. Von T. Koy." 17. " Vorschlag eines neuen auf den Rippenverlauf der flügen gebauten System, von J. D. E. Preyssler."

We are happy in having it in our power to announce the only purely scientific work on Entomology, that has appeared in Britain since the time of Ray. It was published in 1802, by the Rev. W. Kirby, in two volumes octavo, entitled, " Monographia apum Angliæ ;" a Dissertation on the Bees of England. The author commences with an introduction, in which he gives a general view of the rise and progress of this branch of entomology, with remarks on the various works treating of the subject, definitions of the terms used in describing the genera and species by different authors ; and, after pointing out the confusion that had reigned throughout the order Hymenoptera, proposes a new set of terms, with comments on terminology in general. The characters of the order Hymenoptera, with the generic characters, &c. are next given, intermixed with remarks on the economy of each group. Under the head " Addenda," we have some good remarks on other Hymenopterous genera; and at the end of the first volume, a series of outline plates, explaining the various parts of the mouth, &c. peculiar to each sub-

division. The second volume treats of the species, with occasional remarks on the peculiar economy of each. The descriptions are minute, and extremely accurate. It is a fact worth relating, that Latreille, the first of Entomologists, at the same time wrote on the subject, and established similar divisions with those proposed by Kirby, considering each, however, as a peculiar genus. Kirby formed from the Linnean genus Apis two genera, *Apis* and *Melitta*, which answer to Latreille's two families, Apiariæ and Andrenetæ. Latreille's divisions are more numerous and more correct than those of Kirby; but this arose no doubt from the longer experience of the author, and the greater extent of his collection.

"Faune Parisienne (Insectes)," &c. par C. A. Walckenaër. Tom. 1. 8vo. In this work the system of Fabricius is adopted.

"Observationes Entomologicæ, &c. Auctore C. F. Fallén. Lundæ."

"Entomologische Beytrage, Von J. R. Schellenberg. Winterthur." 4to.

"Icones Cimicum. Fas. 3. Auctore J. F. Wolff. Erlangæ." 4to.

"Histoire Naturelle des Fourmis, et recueil de Mémoires et des Observations sur les Abeilles, les Araignées, les Faucheurs et les Autres Insectes." Par P. A. Latreille. Avec figures. Paris, An. x. 8vo. This admirable work is worthy the particular attention of scientific Entomologists.

"Concordance Systématique, servant de table de matières à l'ouvrage de Réaumur, intitule; Mémoires pour servir à l'histoire des Insectes. Par J. N. Vallot." Paris, An. x. 4to.

"Kleiner Beitrag zur Entomologie in einem Verzeichnisse," &c. Von P. Frost. Erstes Heft. Erlangen.

"Coleoptera Microptera Brunsvicentia, &c. distribuit Dr J. L. C. Gravenhorst." Brunsvigæ, 8vo. A most excellent monograph in the genera and species of the genus Staphylinus of Linné.

The "Journal de Physique" for this year contains "Histoire d'un Insecte ou d'un Crustacée," par B. Prevost. This treats of the genus *Branchipus*, incorrectly named *Branchiopoda*.

The sixth volume of the "Transactions of the Linnean Society of London" contains the following entomological papers: 1. "A Dissertation on two Natural Genera hitherto confounded under the name of Mantis." By A. A. H. Lichtenstein. In this paper, *Phasma* is first distinguished from *Mantis*. 2. "Observations on Aphides, to show that they are the principal causes of Blight in plants, and the sole cause of the honey-dew." By W. Curtis. 3. "Observations on the Curculio Trifolii." By W. Marwick, Esq. 4. "Farther Remarks on the same," by M. C. G. Lehmann. 5. "Descriptions of some singular Coleopterous Insects." By C. Schreibers. 6. "Observations on several species of the genus Apis, known by the name of *Humble Bees*." By P. Huber. This last paper is extremely valuable, and will be duly noticed, along with the others, in our article Insecta.

In this year, Mr C. Stewart published anonymously, in Edinburgh, a valuable little work, entitled "Elements of Natural History," the best that has appeared in our language. The greater portion of the second volume is devoted to Entomology. We are sorry to add, that a new edition has lately appeared, in which the author has not availed himself of the important improvements the science has acquired, since the publication of his first edition.

"Observationes Entomologicæ. Pars I. Auctore A. Rönbeck. Lundæ, 1802." 4to.

Mr T. Marsham produced, in the same year, his "Entomologia Britannica," in 1 vol. 8vo; and although it is the worst work (considering the vast advancement of the science at the time) that we have seen, yet, as there was no other on the subject, it has most materially excited the study of entomology in Great Britain.

The "Annales du Museum d'Histoire Naturelle" was commenced this year, and contains a paper by Latreille, entitled "Observations sur quelques Guepes, et description d'une larve et d'une espèce inédite de Casside." The second volume, which appeared in the year 1803, contains "Dissertation critique sur les espéces d'Ecrevisses connues des Anciens, et sur les noms qu'ils leur ont donnés; par G. Cuvier."

"De Animalium exsanguinium Respiratione. Auctore J. F. L. Hausmann. Hannoveræ, 1803." 4to.

"J. C. Fabricii Systema Ryngotorum, &c. Brunsvigæ, 1803." 8vo. Containing descriptions of the species of the orders Hemiptera and Omoptera.

"Genres des Monches Diptères représentés en xlii. Planches projettées et dessinées par M. J. R. Schellenberg, et expliquées par deux amateurs de l'Entomologie. Zuric. 1803."

"Monographia Siricum Germaniæ atque generum illis annumeratorum Auctore D. F. Klug, cum tabulis æreis coloratis 8. Berolini, 1803." 4to. This work contains observations on the genera Oryssus and Sirex, with descriptions of the species.

"Vorschlag zu einer neuen in die Classe der Glossaten einzufuhrenden Gattung Platypteryx von J. H. Laspeyres. Berlin, 1803." 4to.

"Index Alphabeticus in J. C. Fabricii Systema Eleatheraterum genera et species continens. Helmstadii, 1803." 4to.

"Der Gesallchaft Naturforschender Freunde zu Berlin. Vierter Band. Berlin, 1803." Contains, 1. "Herrn S. Laspeyres, Vorslag zu einer neuen in die Klasse der Glossaten einzufuhrenden Gattung." 2. "Herr Prediger Herbst, Beschreibung einiger höchst-seltener Heuschrecken."

"Versuche über die Insecten. Ein Beitrag zur Verbreitung der Nützlichen und Wissenswürdigen aus der Insectenkunde von C. A. Schmid Ester Theil. Gotha, 1803."

"Entomologische Hefte, &c. Frankfort am Main. 1803," 8vo. This work was conducted by Dr J. J. Hoffmann, Dr J. D. W. Knoch, P. W. J. Müller, and J. M. Linz. It contains several admirable monographs, on Hister, Haltica, and Dorcatoma, which are illustrated with coloured figures very neatly executed.

"Magazin für Insectenkunde, herausgegeben von

Karl Illiger. Zweiter Band. Braunschweig." Contains, "1. Vertheidigung der Fabrichschen Systems, von J. C. Fabricius." 2. "Nachcrift der Herausgebers zu vorstehenden Aufratze." 3. "Etwas über Gattung, Gattungskennzeichen und Gattungsbenunnung von J. C. G. Karsten." 4. "J. H. Laspeyres Kritische Revision der neuen Ausgabe der Systematischen Verzeichnisses von der Schmetterlingen der Wienergegende." 5. "Auseinandersetzung von zwei unter dem namen *Runica* bischer verweichsalten Tagfalter Arten. *P. Runica* und *P. Medesicate*." 6. "Verzeichniss der in Portugall einheimische Käfer Erste Leiferung." 7. "J. W. Meigen's Verseuch einer neuen Gattungs-Eintheilung der Europaïschen Zweiflügligen Insecten." 8. "Literatur." 9. "Vermischte Nachrichen und Bemerkungen."

A. H. Haworth published the first part of an elaborate work, entitled Lepidoptera Britannica, the object of which was to give descriptions of the various species of that beautiful order which inhabit Britain. The task was a very difficult one, and the author has, in our opinion, acquitted himself with considerable credit. Two other parts have since appeared, but the work is still incomplete, one part still remaining unpublished.

"Voyage en Hongrie, &c. par R. Townson. Traduit de l'Anglais par Cantwell. Tom. 3. Paris, 1803." 8vo. The original appeared in 1797.

"D. J. F. Blumenbach's Handbuch der Naturgeschite. Göttingen." 8vo. The seventh edition. A French translation appeared at Mentz during the same year.

Lastly, in the third Volume of the Annales du Museum, two papers by Latreille. 1. Observations sur l'Abeille parietine, &c. et Considerations sur le genre auquelle se rapporte: 2. Des Langoustes du Museum National d'Histoire Naturelle.

J. C. Fabricius published, in 1804, his "Systema Piezatorum, &c. Brunsvigæ."

And J. W. Meigen his celebrated "Klassificazion und Beschreibung der Europaischen Zweiflügligen Insecten (Diptera, *Linné*). Braunschweig. Ester Band." 4to.

"Archiv für die Systematiche Naturgeschite heraugegeben von Dr F. Weber, und Dr D. M. H. Mohr. Ersten Bandes, Erstes Stükk. Leipzig. 1804."

"Icones Cimicum. Fasc. IV. Auctore J. F. Wolff. Erlangæ, 1804." 4to.

James Sowerby published the first number of his "British Miscellany," in 8vo. The few insects figured are highly interesting, but the work, from want of a liberal support, was never continued beyond 12 or 15 numbers.

The seventh volume of the "Transactions of the Linnean Society of London" appeared this year, in which is a paper by William Roxburgh, M. D. on "The Tussech and Arrindy Silkworms of Bengal," which the author informs us produce the Phalæna Mylitta *Drury* ii. T. V. f. 1; and the P. Cynthia *Drury* ii. T. VI. f. 2.

The "Dictionnaire des Sciences Naturelles, par plusieurs Professeurs du Muséum, &c." commenced. The entomological part by Professor Duméril.

The Journal de Physique for the year contains "Essai sur l'Entomologie médicale, par Chaumaton."

"Illustrationes Insectorum Iconographica, &c. Auctore A. J. Coquebert. Tab. Dec. III. Parisiis, An. x. (1804)." 4to. In it are published figures of the species described by Fabricius, from the Parisian cabinets.

"Notice des Abeilles proprement dits; par Latreille." *Annal. du Mus.* Tom. IV.

"Natursystem aller bekannter in-und Ausländischen Insecten. Von J. F. W. Herbst. Der Schmetterlinge mit 30 illumen. Berlin, 1804." 4to.

Illiger's Magazin for this year contains, "1. Familien, Gattungen und Horden der Kafer, *Coleoptera*, von P. A. Latreille: 2. Namenweiser der Familien und Gattungen in Latreille's System der Käfer: 3. Zusätge, Berichtigungen und Bemerkungen zu Fabricii Systema Eleuteratorum. Tom. I.: 4. Alphabetisches Verzeichniss zu J. Hübner's Abbildungen der Papilionem mit biegefägten Synonymen von J. C. Grafen von Hoffmansegg: 5. Essbåre Insecten und eine neue art vom Spinnen: 6. Neuere Insectenwerke: 7. Vorschlag einer neuen Tödtungsmethode der Insecten von M. J. Böhm, und Vertilgung der Borkkäfers, *Ptinus Far*, von Malinowsky: 8. Vermischte Bemerkungen." The same work for 1805 contains the following highly interesting papers: "1. J. H. Laspeyres Kritishe Revision der neuen Ausgabe des Systematischen Verzeichnisses von der Schmetterlingen der Wiemergegend: 11. Theil: 2. Zuoätze, Berichtigungen und Bemerkungen zu Fabricii Systema Eleuteratorum. Tom. II: 3. Beiträge zur Naturgeschite des Halbdehigen Leuchtkäfers, *Lampyris hempitera*, Tab. von P. W. J. Muller: 4. Bemerkungen uber die Fussgliederzahl einiger Käfergattungen in Bezichung auf Illiger's Abhandlung uber diesen Gegenstand in dem Magazin fur Insectenkunde. I. B. p. 185. von P. W. J. Muller: 5. Die Hauschrekkenzüge in mittäglichen Africa. Auszüge ans Barrow's Reise in der Kolonien auf den Vorgeberg der Gattung Hoffnung."

A very interesting work on the various animals that produce a phosphorescent appearance in the sea was published this year. It contains figures of seven new minute species of Edriophthalmous Malacostraca. The book is entitled, "Phosphorescentia maris quatuordecim Lacentium Animalculorum novis speciebus illustrata a Dominico Viviani, &c. cum Tabulis æreis quinque. Genuæ, 1805." 4to.

"Tableau des Araneïdes, &c. par C. A. Walckanaër. Paris, 1805." 8vo. This work comprehends the characters of the genera belonging to the natural family Araneidæ, with excellent observations on the parts comprising the mouths, &c. of this interesting group.

"Kritische Revision der Insectenfaune Deutchlands, nach der System bearbeited von Dr G. W. F. Panzer. I.—xcvi. Heft 1. Bandchen. Nürmberg, 1805." 12mo.

"J. C. Fabricii Systema Antliatorum, &c. Brunvigæ, 1805." 8vo.

"G. A. Goldfuss Enumeratio Insectorum Eleutheratorum Capitis Bonæ Spei totiusque Africæ, cum tabula ærea. Erlangæ, 1805." 8vo. Eight new species are described and figured.

"Fauna Austriæ, oder Beschreibung der österreichischen Insecten, &c. Von G. Duftschmid. Ester Theil. Linz und Leipzig. 1805." 8vo.

"Deutschlands Insecten. Von J. Sturm. 1. Bändchen. Kafer. Nüremberg, 1805. mit 20 Kupfertapeln." 8vo.

"Insectes recuilles en Afrique et en Amerique, &c. par Palisot de Beauvois. Paris." fol.

E. Donovan gave to the world another work on exotic insects, in quarto, entitled, "An Epitome of the Insects of New Holland, New Zealand, &c." This publication is extremely valuable, the figures generally very correct, and the work is rare, few copies having been published.

Lastly, "Vollständige Naturgeschite der Schädlichen Forstinsecten, &c. Von J. M. Bechsteine und G. L. Scharfenberg, mit 13 Quartkupfern. Leipzig." 4to.

In 1806, C. Duméril published his "Zoologie Analytique, ou Méthode Naturelle de Classification des Animaux, &c. Paris." 8vo. In which the *Insecta* and *Arachnoïda* are classed together. All the genera are given in tables, in a clear point of view.

P. A. Latreille produced the first volume of his "Genera Crustaceorum et Insectorum. Paris." 8vo. Two more volumes appeared during the following year, and a fourth in 1809. This is by far the best systematic work hitherto published; but as, in our article Insecta, we shall follow the general outline of his system, it will be unnecessary to say more on the subject in this place.

Dr G. W. F. Panzer published a tract on Hymenoptera, entitled "Entomologischer Versuch die Jürineschen Gattungen de Linneschen Hymenoptera nach dem Fabriciusschen System zü Prüffin, &c. Nürmberg." 8vo.

"Handbuch der Neuesten Entdeckungen in der Hielmittellehre, von K. F. Burdach. Leipzig." 8vo.

"Svensk Entomologi ab C. Iser. Linköping." 8vo.

"Svensk Zoologi, eller Svenska Djurens Historia, börjad ab C. Quesnal, forstatt ab O. Swartz, utgifver med illuminerande figurer ab J. W. Palmsturch. Stockholm." 8vo.

"Die Schmetterling Sachens, &c. Von F. Ochsenheimer. Erst. Th. Leipzig. 1806." 8vo.

"Entomologie Helvetique, &c. Tom. II. Zurich, 1806." 8vo. This volume treats of the Carabidæ and Dyticidæ.

"Monographia Coleopterum Micropterum, auctore J. L. C. Gravenhorst. Gottingæ, 1806." 8vo.

"Natursystem aller befannter in und Ausländischen Insecten, &c. Von J. F. W. Herbst. Berlin, 1806." 8vo.

The seventh volume of the "Annales du Museum d'Histoire Naturelle" contains, 1. A Memoire by Drandebart de Férrussac fils, on two new species of Entomostraca and Hydrachna: 2. An excellent Dissertation on the Argulus foliaceus, the whole history of which is admirably detailed: 3. A paper by Lepellitier, on several new species of the family Chrysididæ, with good remarks on the group in general, accompanied with figures.

Illiger's Magazin, too, contains some highly interesting papers: 1. "Züsäge zur Terminologie der Insekten:" 2. "W. Kirby's Famien der beinenarten Insekten mit Zuzärzen, Naturweisungen und Bemerkungen:" 3. "Ester Nachtrag zu des Graffen von Hoffmansegg Alphabetischen Verzeichnisse von Hubner's Papilionem. Durch denselben." 4. "Beschreibung der um Odenbach in Departement vom Donnerberg blobrachten Schlammkäfer, Limnius *Illiger*, von P. W. J. Muller." 5. "Beschreibung einer neuen käferguttung: Macronychus, mit der Beschreibung einer neuen art von Parnus, von P. W. J. Müller." 6. "Nachtrag zu der Zusärtzen, Bemerkungen und Berichtigungen zu Fabricii Systema Cleuteratorum:" 7. "Mittel gegon die Blattlause."—The same work for 1807 contains, 1. A paper on 160 species of Heltica: 2. A paper on Portuguese Insects; and, 3. what is by far the most interesting of all, An analysis of Fabricius Systema Glossatorum, as far down as Sphinx.

L. Jurine published his "Nouvelle méthode de Classer les Hymenoptères et les Diptères. Avec figures. Tom. I. Hymenopteres. Geneve. 1807." 4to. An analysis was published in the Journal de Physique of the same year. The author has proposed to arrange into genera the two orders mentioned in his title, solely from the wing-bones, a method by no means new, having been before proposed by Moses Harris, and adopted, to a certain extent, by after writers.

The first part of the "Transactions of the Entomological Society of London" was published this year, and contains notices of several insects not before observed in Great Britain.

An elegant work on the finer exotic Butterflies appeared, entitled "Coloured Specimens, to illustrate the Natural History of Butterflies, from the collection of Mr Lee of Hammersmith." This publication is illustrated by twenty copperplates, so admirably coloured as to resemble highly-finished drawings.

"Observationes Entomologiæ. Pars II. auctore D. Danielsson, Lundæ, 1807." 4to.

"Observationes Entomologiæ. Pars III. auctore P. N. Block, Lundæ, 1807." 4to.

"Monographia Cantharidum et Malachiorum Sueciæ, auctore J. E. Arrhenius, Lundæ, 1807."

"Monographia Cimicum Sueciæ, auctore C. F. Fallén, Hafniæ, 1807." 8vo.

"Deutschlands Fauna, &c. Von J. Sturm. V. Ubtheilung. Die Insecten. Zweites Bändchen. Kafer. Mit 32 Kupfertafeln. Nürmberg, 1807." 12mo.

"Die Schmetterlinge von Europa. Von F. Ochsenheimer. Est. Band. Leipzic, 1807." 8vo.

In the "Nouveau Bulletin des Sciences, par le Société Philomatique de Paris, Tom. I. 1807." 4to. are the following good papers: 1. "Mémoire sur les Mœurs de Ceratina albilabris, *Latr.* par M. Spinola." 2. "Note sur quelques habitudes des Abeilles-bourdons, par A. de Petit-Thouars."

The tenth volume of the "Annales du Museum" contains, "Memoire sur les Mœurs de Ceratina albilabris. Par M. Spinola."

The "Gesellschaft Naturforschender Freunde zu Berlin, 1807," contains, 1. "Arten von Krebsen, von Schneider." 2. "Anatomie der Darmkanals und

der Geschlechtstheile vom Carabus monilis, vom Dr Ramdohr." 3. " Uber das Leuchten der Fulgorem, als Nachtrag zur vorhergehender Abhandlung, von Graf Hoffmansegg." 4. " Uber die Geschechtverschiedenheit der Piezaten, vom Dr F. Klug." 5. " Monographie der Elateren mit leuchtenden Flecken auf dem Halsschilde, von K. Illiger." 6. " Oxæa, eine neue gattung aus der Ordnung der Piezaten, von F. Klug." 7. " Species Apiarum Familiæ novas descripsit, &c. F. Klug." 8. " Ein neuer Merkwürdiger Henops, beschrieben, von F. Klug." The same work for 1808 contains, 1. " Ueber die Geschlechtsverschiedenheit der Piezater, von D. F. Klug." 2. " Ueber die Gattung Cypris *Müller*, vom F. A. Ramdohr." 3. " Beytrag zur Naturgeschichte der Vespa Crabro, von Malinowsky." 4. " Tinea sociella und colonella, die beiden Geschlechter einer Art, von S. Laspeyres." 5. " Die Blattwespen nach ihren Gottungen und Arten Zusammengestellt, vom F. Klug." This last paper has since been followed up by several others on the same subject; they contain most accurate descriptions of all the species of Terthedo *Linné*, that have been hitherto discovered.

The second part of Schönher's " Synonomia Insectorum" came out this year; and a very interesting work on the insects of Sweden, " Insecta Suecica descripta a L. Gyllenhall," Tom. I.; comprehending the most detailed descriptions of the Coleoptera that we have yet seen.

The ninth volume of the " Transactions of the Linnean Society of London" contains, 1. An excellent " Monograph on the Genus Apion, by the Rev. W. Kirby." 2. " Some Observations on the Wheat Insect, supposed to be the Wire-worm, by T. Walford, Esq. with notes by T. Marsham, Esq." 3. " Descriptions of *notoclea*, a new genus of Coleopterous Insects, from New Holland, by T. Marsham, Esq." This genus had long before been established by Olivier, under the name *Paropsis*.

" Die Schmetterlinge von Europa. Von F. Ochsenheimer. Est. Band." 8vo.

The " Annales du Museum, Tom. XI." contains " Notice biograph. sur J. C. Fabricius. Par Latreille." And Vol. XII. of the same work, for 1809, contains, 1. " Nouvelles observations sur le manière dont plusieurs insectes de l'order hyménoptères pourvoient à la subsistance de leur posterité; par Latreille." This memoir consists of some very interesting observations on the economy of the genera Bembex, Philanthus, Anthophora, and Parnopes. 2. " Comparison des organes de la mastication des Orthoptères, avec ces des autres animaux; par Marcel de Serres." The learned author of this paper details the variations presented in the teeth of the mandibles, and at the same time points out the functions he believes them to be destined to perform, in omnivorous, graniverous, and carnivorous orthoptera. He says, that the carnivorous have only the canine teeth; the herbivorous genera have incisors and grinders, and the omnivorous have canine and grinders, but that the latter are smaller, and the former less pointed than in the carnivorous and herbivorous genera. 3. " Mémoire sur les Métamorphoses du grand Hydrophile," par M. Miger.

" Essai sur l'Entomologie du Département du Puy-de-dome. Par J. B. L. Monographie des Lamelli-antennes. Clermont, 1809." 8vo.

The " Der Gesellschaft Naturforschender Freunde zu Berlin," 1809, contains, " Bemerkungen über die Lebenverhältnisse der Coccinellen überhaupt, und der Coccinella hieroglyphica, *Fabr.* insbesonder vom P. D. Reich."

The " Journal de Physique, Tom. LVIII." of this year, contains, " Mèmoir sur les yeux composés et les yeux lisses des Orthoptères, &c. par Marcel de Serres."

" F. A. Bonelli, Observations Entomologiques, Turin, 1809," 4to, containing a monograph on the European genera of the Linnean genus Carabus, which he has admirably divided into natural genera, and distributed them into stirpes. It is a complete model for classification.

The " Berlin Magazine for 1809" contains, " Bemerkungen über die Sebensverhältnisse de Coccirellem, &c. Von Reich."

" G. Bayle Saggio intorno agli Insetti n ouvi,&c. Milano, 1809." 8vo.

The " Annales du Museum," Tom. XIII. of the year contains, 1. " Latreille sur le genre Anthidium de Fabricius," &c. in which the species are very well described. 2. " Jules de Tristan; Mémoire sur quelques crustacés trouvés sur les côtes de Poitou." In this paper five species of our genera Dynamene, Næsa, and Idotea are described and figured.

In 1810, Latreille published his " Considerations sur l'Ordre naturelle des Crustacés des Arachnides, et des Insectes." 8vo. A most excellent little manual for the scientific student.

" Die Schmetterlinge von Europa. Von F. Ochsenheimer. Ditter. Band."

" Specimen Entomologicum Novam Dipteræ deponendi methodum exhibens. Auctore M. Rodhe. Lund. 1810." 8vo.

In the " Nouveau Bulletin des Sciences," we find a paper on a new genus of Diptera, named Nemestrina by Latreille, by Olivier.

" E. F. Germar, Systematis Glossatorum Prodromus, sistens Bombycum, species secundum oris partium diversitates in nova genera distributosa. Sectio 1. Leipzic, 1810." 4to. Of this work we shall say more under the article INSECTA.

" Insecta Sucica descripta a Leonardo Gyllenhall, Tom. I. par 2. Scaris, 1810." This part treats of the Cicindelidæ, Carabidæ, Staphylinidæ, Meloïdæ, &c. and is equal to the first part in merit.

The " Berlin Magazin" contains, 1. " Einige neue Piezatengattungen, von Dr F. Klug;" and the same work for 1811, 1. " Ichneumones adciti in genera et familias diversi a Dr Nees ab Esenbeck."

" Icones Cimicum. Fas. V. Auctore J. F. Wolff. Erlangæ, 1811." 4to.

" G. A. Paykull, Monographia Histeroïdum. Upsaliæ, 1811. Cum tablis 13. æreis." 8vo. This is by far the best production of this author. In it he has described and figured all the species he had an opportunity to examine, and has separated certain species under the generic title *Hololepta;* he has, however, figured the larva of a Dipterous Insect, for that of his new genus.

The second part of the tenth volume of the "Transactions of the Linnean Society of London" contains, 1. "Descriptions of several new species of Apion, by the Reverend W. Kirby." 2. "Some account of an Insect that was taken alive out of a desk that had been made for more than twenty years, by T. Marsham, Esq."

The Annales du Museum, Tom. XVII. et XVIII. contain, 1. "Mémoir anatomique sur un nouvelle espèce du genre Brachinus, par L. Dufour," in which the author shows us the organs by which this genus of Insects prepare and emit the fumes and cause the explosion by which their economy is characterized. This paper is republished in Vol. III. of the Nouveau Bulletin des Sciences for 1812. 2. "De l'Odorat et des Organes qui paroissent en être le siége, chez les Orthoptères, par Marcel de Serres;" wherein he combats the generally received opinion that Insects smell by their antennæ or respiratory tracheæ, and seems disposed to think that the Orthoptera probably receive this impression through the medium of the membranaceous points of their palpi.

In the Berlin Magazine for 1811, there is a paper by Nees Von Esenbeck, on the Ichneumones adsciti.

The same work for 1812, Tom. XIX. contains a Mémoire by Latreille, entitled, "Sur un Insecte qui les Anciens réputoient fort venimeux, et qu'ils nommoïent Bupreste," in which he attempts to prove the *Buprestis* of the ancients to have been a Meloë, or an insect of the same natural family.

"A. Ahensii, Fauna Insectorum Europæ. Fas. I. Ic. XXV. Halæ. 1812, 12mo."

"Insectes de l'Amérique Equinoctiales, &c. Par Latreille. Seconde Partie. Paris, 1812." fol.

"Fauna Austriæ. Zwenter Thiel. Linz un Leipzig. 1812." 8vo.

"Observationes Entomologiques traduites et extraites d'un ouvrage inédit intitulé. J. N. Vallot, Insectorum incunabula juxta methodicum disposita, &c. Paris, 1812." The Insects are classed according to the plants on which they feed.

"E. F. Germar Systematis Glossatorium prodromus, &c. Sectio II. Leipsiæ, 1812."

"G. R. Treviranus über den Bau der Arachnider. Erlangæ, 1812."

In the fertile year, 1813, were published, "K. A. Ramdohr Abhandlung über die Verdauungswerkzeuge der Insecten, Halle. Mit 30 Kupfertafern." 4to.

"Insectes de l'Amérique Equinoxiale, Par Latreille. Paris, 1813. Partie II." fol.

"Mémoirs de l'Académie Impériale des Sciences de St Petersbourg, Tom. IV. St Petersbourg, 1813." Contains, 1. "Coleoptera rostrata Capersia, a C. P. Thunberg illustrata."

"E. F. Germar, Resie nach Dalmatien und in das Gebiet von Ragusa. Leipzig, 1813. Mit Kupfern." 8vo.

"L. Gyllenhal, Insecta Svecica, Tom. I. Pars 3. 1813." Contains the continuation of the Coleopterous families Bruchidæ, Cusculionidæ, Erotylelidæ, and Chrysomelidæ.

"Specimen novam Hymenoptera disponendi methodum exhibens, &c. Auctoribus C. M. Hellesträm, C. J. Danielson, et C. A. Lundman. Lundæ, 1813." 4to." In this work, the Hymenoptera are distributed into eighteen families, and seventy-one genera, the characters being founded on the form of the antennæ and body, and on the variations in the wing-bones.

The "Noveau Bulletin des Sciences, Tom. III. Pairs, 1813," contains, 1. "Essai Historique sur les Crustacées de la mer de Nice; par Risso." 2. "Extrait d'un Mémoire sur le Puceron du Thérébinth, &c. par D'Audebard de Ferrussac." 3. "Extrait d'un Mémoire sur les Araignées; par Lepellitier."

The "Journal de Physique, Tom. LXXVI. 1813," contains, 1. "Extrait d'un Mémoire sur les usages des diverses partes du tube intestinal des Insectes. Par Marcel de Serres." 2. "Rapport fait par Mr Bosc, sur l'ouvrage de Mr Hubert fils, intitule, Recherches sur les Mœurs des Fourmes indigènes."

"Index Entomologicus, sistens omnes Insectorum species, in G. W. Panzeri, Fauna Insectorum Germaniæ descriptas, &c. Pars I. Norimb. 1813." The author, in this index, has availed himself of the observations of Latreille, Borelli, and other celebrated writers.

"Mémoire sur les yeux composés et sur les yeux lisses des Insectes, &c. Par Marcel de Serres. Montpellier, 1813." 8vo. It would be ridiculous to eulogise a man so celebrated as Marcel de Serres. In this work, which is illustrated with beautiful plates, he has shown us that the optic nerve, in Insects with compound eyes, is distributed by separate fibres, one to each fascette, composing the eye itself. And that the simple eyes are supplied, each one, by a peculiar branch of the optic nerve, the branches themselves uniting before they join cervical (or cerebral) ganglion.

"G. J. Billberg, Monographia Mylabridum. Holmæ, 1813. Cum tabulis 7 æreis coloratis." 8vo.

In this year Germar commenced an excellent journal on Entomology, which may be considered as a continuation of Illiger's Magazine. It is entitled, "Magazin der Entomologie. Von Dr E. F. Germar, Halle, 1813." 8vo. It contains, 1. "Naturgeschichte des Carabus gibbus (Zabrus gibbus), eins saatverwüsttenden Insekts. Von Herausgeber." 2. "Insecten in Berstein eingeschlossen, beschrieben; Von Herausgeber" 3. "Bemerkungen über die Sachträger unter der Schmetterlingen ehre Fortpflanzung und Entwiehelung. Von Dr Zinken *gennant* Sömmer."

The first part of Vol. XI. of the "Transactions of the Linnean Society of London" contains, 1. "An Essay on the British species of Meloë, with descriptions of two exotic species, by W. E. Leach." 2. "Strepsiptera, a new order of Insects, &c. By the Reverend W. Kirby." 3. "A Monograph on the British species of Choleva, by W. Spence, Esq."

Vol. XX. of the "Annales de Museum" contains, "Observations sur les diverses parties du Tube intestinal des Insectes. Par Marcel de Serres." In this learned memoir, we find a complete account of the intestinal canal of Insects, which always consists of the œsophagus, the stomach, biliary vessels, and intestines. The last part presents a vast number of modifications. In very voracious Insects, and in

those whose masticatory organs are not well developed, a supplementary part may be observed, which is not very unlike the gizzard of birds. After giving an account of the coats that enter into the composition of the canal in its different parts, he informs us, that the length of the œsophagus depends on the form of the thorax. In some instances, it is as long as half of the intestinal canal, and at other times it varies from one to nine or twenty-six. The stomach is likewise variable in its size, according to the functions designed for it to fulfil. The intestines are generally longer in herbiverous Insects, than in those that feed on living bodies. We regret that our space will not allow us to give a detailed analysis of this valuable memoir, to which we refer those of our readers who wish to learn farther particulars.

In 1814 was published, "Précis des Decouvertes Somiologiques ou Zoologiques et Botaniques, par C. S. Rafinesque. Palerme, 1814." 12mo. In this little work, which contains indications of several new genera and species, the Crustacea are termed Plaxolia, and the Insects Entomia.

"Nouvelles Observations sur les Abeilles. (2de edit.) Paris, 1814." 8vo. For an account of this work, see article BEE, Vol. II. p. 212.

"Anthracides Sueciæ, auctore E. H. Berglund. Lundæ, 1814." 4to.

"Hydrocorides et Naucorides Sueciæ, auctore J. G. Liljegren. Lundæ, 1814." 4to.

"Diptera Sueciæ distripta a C. F. Fallen. Tom. I. Lundæ, 1814." 4to.

"Asilici Sueciæ, auctore J. G. Waldenström. Lundæ, 1814." 8vo.

"Specimen novam Hemiptera disponendi methodum exhibens, auctore M. Rodhe. Lundæ, 1814." 4to.

"L'Art Entomologique, Poëme didactique. Par Mr Le Roux. Versailles, 1814." 8vo. This volume, although in Rhyme, is not devoid of merit, and will not prove uninteresting to the entomologist.

"A. Ahensii, Fauna Insectorum Europæ. Fas. 2. ic. 25. cum descriptionibus. Halæ, 1814." 12mo.

"C. L. G. Löwe, de partibus quibus Insecta spiritus ducunt. Dissertatio inauguralis Med. Halæ, 1814." 8vo.

The "Bulletin des Sciences, 1814," contains, 1. "Sur une nouvelle éspece du genre Cymothoa de Fabricius, par Le Sueur." 2. "Observations sur la bouche des Papillons, &c. par J.-C. Savigny."

The "Berlin Magazine for 1814" contains, 1. "Die Körpertheile der Zweiflüglichen Insecten. Ein terminologischer versuch; von P. F. Bouché." 2. "Die Blattwespen, &c." and 3. "Die Europaischen Arten der Insecten gattung Leucospis; von F. Klug." 4. "Ichneumones adsciti in genera et familias divisi, a Nees von Esenbeck."

"The Zoological Miscellany; or Descriptions of New, Rare, or Highly Interesting Animals, by William Elford Leach. Illustrated with Coloured Figures, by R. P. Nodder." Vol. I. This work contains descriptions and figures of several new and curious genera and species of insects. A second volume was published in 1815.

"Empidæ Sueciæ, &c. auctore P. N. Rhodin. Lundæ, 1815." 4to.

"Platypezinæ et Bombyliarii Sueciæ, &c. auctore L. F. Flodin. Lundæ, 1815." 4to.

"C. Spengel, Commentarius de partibus quibus Insecta spiritus ducunt. Accedunt Tab. 3. æri incisæ et pictæ. Lipsiæ, 1815." 4to.

"J. Sturm, Deutschlands Fauna. Drittes Bändchen. Käfer. Nürnberg, 1815." 12mo.

"Monographia Ichneumonum Pedestrium, &c. auctore J. L. C. Gravenhorst. Lipsiæ, 1815."

"H. M. Gaede, Beiträge zür Anatomie der Insekten. Altona, 1815. Mit 2 Kupfertafeln." 4to.

"Dr Herold, Entwickelelungs-Geschichte der Schmetterlinge, Anatomisch und Physiologisch bearbeitet, 1815. Mit 33 Kup." 4to.

The "Mémoires du Muséum d'histoire naturelle, &c. Tom. I." This is a new series of the "Annales du Museum;" it contains, "Note sur les Mœurs des Bourdons, par La Billardiere."

The "Mémoirs de l'Académie Imperiale des Sciences de St Pétersbourg, Tom. V. 1815," contains, 1. "Hemipterorum maxillosorum genera, &c. a C. P. Thunberg." 2. "De Cancris Camtschaticis, Oniscis, Entomostracis, et Cancellis marinis microscopicis noctilucentibus, cum appendice de Acaris et Ricinis Camptschaticis, auctore Tilesio."

"Magazin der Entomologie, herausgegeben von Dr E. F. Germar, Halle, 1815," 8vo. contains, 1. "Eenige Erfahrungen und Bemerkungen, von J. F. Kyber." 2. "Abhandlung über die Gattung Anthidium, *Fabr.* von P. A. Latreille." This is extracted from Vol. XIII. of the "Annales du Muséum. 3. "Südamerikanische Insecten gesemmelt, von V. Humboldt und Bonpland, von P. A. Latreille."

The "Berlin Magazine" contains, 1. "Lapton femoralis, eine neue Ichneumonidengattung, &c. Von Neees von Esenbeck." 2. "A continuation of Klug's descriptions of the Tenthredinæ." 3. "Die Gattung Leucosia, *Fabr.* Von P. Lichtenstein."

"An Introduction to Entomology, &c. By W. Kirby and W. Spence. Vol. I. London, 1815." 8vo. This is a popular book, published with a view to excite to the study of Entomology. Vol. II. appeared in 1817. The third volume, we understand, will contain the nomenclature.

"Transactions of the Linnean Society of London," Vol. XI. Part II. contains, 1. "Observations on the Cancer Salinus of Linnæus, by the Rev. T. Racket." 2. "Addendum to the Strepsiptera, by the Rev. W. Kirby." 3. "Further observations on the Meloë, with descriptions of six exotic species, by W. E. Leach." 4. "A tabular view of the external characters of four classes of Animals, which Linné arranged under INSECTA; with the distribution of the genera, composing three of the classes into orders, &c. and descriptions of several new genera and species, by W. E. Leach."

In 1816, the most philosophic work that we have seen, was published, entitled, "Mémoires sur les Animaux sans Vertèbres, par Jules-César Savigny. Premier Partie, 1st Fascicule, Mem. 1–2. Théorie des Organes de la bouche des Crustacés et des In-

sectes. Paris, 1806." 8vo. In this work the author has proved in a most satisfactory manner, that the mouths of all Insects, Crustacea and Myriapoda, are composed of one pair of mandibles, and two pairs of maxillæ; and that the lower lip of Insects is formed by the union of the second pair of maxillæ. In the Myriapoda the lower lip is composed of the two pairs of maxillæ confluent, their mandibles being soldered to it. The two anterior pairs of thoracic legs are, in the same class of animals, converted into auxiliary lower lips, the third pair only assisting them in locomotion, which is performed by the ventral or abdominal legs. The mandibles in Lepidoptera perform no function, they are but rudimentary. The first pair of maxillæ in the same order is prolonged into a spiral tongue, bearing palpi at its base; and the lower lip is composed of the exterior maxillæ united, like that of all other insects. We earnestly recommend this treatise to those occupied with the study of entomology.

" Empides Sueciæ, auctore N. Kihlgren. Lundæ, 1816.' 4to.

" Observations sur le Xenos Vesparum, par M. Jurine."

" Histoire naturelle des Crustacés des Environs de Nice, par A. Risso. Ornée de Graveures. Paris, 1816." 8vo. A most valuable work, containing a vast number of observations relating to the economy of these animals.

" Die Schmetterlinge von Europa. Von F. Ochsenheimer. Bieter Band, 1816."

" Dr H. T. L. Reichenbach Monographia Pselaphorum. Lipsiæ, 1816. Cum tabulis coloratis 2." 8vo.

" Malinousky, Elementarbuch der Insectenkunde, vorzügluh der Käfer. Quedlinburg bei Basse, 1816." 8vo.

Two new editions of the " Nouveau Dictionnaire d'Histoire Naturelle," &c. were commenced this year; the first, entitled, " Dictionnaire des Sciences Naturelles, &c. par plusiers Professeurs du Jardin du Roi," &c. The articles on insects are written by Professor Duméril; those on Crustacea by Dr Leach, correspondent of the French Museum. One volume is published quarterly. The second professes only to be a new edition, and retains the old title. The Entomological articles are written by Latreille. One volume is produced every month. The first volume contains the interesting articles, Abeille, Argule, Araignée, Aile, and Bouche.

The " Journal de Physique, &c. Tom. LXXXII. and LXXXIII.," contain, 1. " Observations sur la filiation des Animaux, depuis le Polype jusqu'au Singe, par De Barbançoise." 2. " Observations pour servir à une classification des Animaux, par le même." 3. " Prodrome d'une nouvelle distribution Systematique des Regne Animal, par H. D. de Blainville;" in which the author has distributed the Linnean Insecta into the following classes. 1. With six legs, Héxapodes (or insects properly so called). 2. With eight legs, Octopodes (Spiders and Acari). 3. With ten legs, Decapodes (Malacostraca, with pedunculated eyes, excepting Squilla). 4. Legs variable in number, Hétéropodes (Squilla, Branchipus, &c.). 5. Legs fourteen, Tétradécapodes (our sessile eyed Malacostraca). 6. Legs equal in number to the joints of the body (Myriapoda).

The " Bulletin des Sciences," for the year, contains, 1. " Sur une nouvelle distribution des Classes des Crustacés, des Myriapodes et des Arachnides, par W. E. Leach." 2. " Prodrome d'une nouvelle distribution systematique du Règne Animal, par H. de Blainville."

" Synopsis of four new species of Crustacea found in the United States, by C. S. Rafinesque, Esq." This notice is published in the " American Monthly Magazine, Vol. II., New York, 1817." 8vo.

" Insectes de l'Amerique Equinoctiale, &c. par Latreille, Partie 2."

" Synonymia Insectorum, von C. J. Schönherr, Ester Band. Skara, 1817. (Hispa-molorchus)." Also, " Appendix ad C. J. Schönherr, Synonymia Insectorum, Tom. I. Sistens descriptiones novarum specierum."

The " Massachusett's Agricultural Repository and Journal, Vol. IV., Boston, 1817," 8vo, contains a paper by Professor Peck, " On the Natural History of two Insects; the one a Scolytus, the other a Rhynchænus."

" Transactions of the Linnean Society," Vol. XI. Part 1. contains, " On the Classification of the Notonectidæ, by W. E. Leach."

" Journal of the Academy of Natural Sciences of Philadelphia, Vol. I., 1817." 8vo. This volume contains some excellent papers on the Crustacea of the United States, by Thomas Say, Esq. who has studied the subject with great success, and has discovered and described several very interesting new genera and species.

" J. A. C. Sturm, Deutchlands Insecten, Zweites Bändchen. Käfer, mit 32 Kupfertofeln, Nürnberg, 1817." 8vo.

" Mémoires du Museum, &c. Tom. III., 1817," contains, 1. " Introduction à la Géographie générale des Arachnides et des Insectes, ou des Climats propres à ces animaux, par P. A. Latreille." 2. " Considerations nouvelles et generales sur les Insectes vivant en Société, par le même."

" American Entomology, &c. illustrated by coloured figures, by T. Say, Vol. I. No. 1., Philadelphia, 1817." 8vo. This work promises to be of great utility to the science, and to make us acquaintted with the but little investigated entomological treasures of North America.

" Magazin der Entomologie, Herausgegeben, von Dr E. F. Germar und Dr J. L. T. F. Zincken *genaunt* Sommer, Halle, 1817." Contains, 1. " Beiträge zur Verwandlurgeschte einiger Käferarten, von J. F. Kyber." 2. " Die Linneischen Tineen in ihre natürlichen Gottungen aufgelöft und beschrieben, von J. L. T. F. Z. g. Sommer." 3. " W. Kirby's Monographie des Gattung Apion *Herbst*, aus dem Englischen übersetzt, mit Bemerkungen und eingeschalteten Beschreibungen neuer arten, von E. F. Germar." This dissertation not only contains the species described by Kirby, but a vast number of new species, which are illustrated by several very neatly coloured figures. 4. " Bemerkungen über einige Insekten, von P. W. J. Müller."

" Le Regne Animal, &c. par M. Le Chevalier

Cuvier, Vol. III., continent, "Les Crustacés, Les Arachnides, et Les Insectes, par M. Latreille." The Crustacea are arranged into five orders, viz. 1. *Decapodes*, comprehending our orders Brachyura and Macroura. 2. *Stomapodes*, including Squilla. 3. *Amphipodes*, embracing our first division of the Edriophthalma, or those with compressed bodies. 4. *Isopodes*, under which he has placed the Onisci of Linné, or our Edriophthalma with depressed bodies. 5. *Branchiopodes*, or the Entomostraca of Müller. The Arachnoïda he divides into two orders. 1. *Pulmones* (Unogata, *Fabr.*). 2. *Trachéennes;* but the characters have not directed his classification rigorously. The Myriapoda he has placed with the insects, of which they form the first order. To the orders given in his Genera Insectorum, he has added Rhipiptera (Strepsiptera, Kirby), which is placed between the Hymenoptera and the Diptera.

The "Mémoires du Museum, Tom. IV.," contains, "Observations sur les usages du Vaisseau dorsal, &c. par Marcel de Serres."

"The Zoological Miscellany, Vol. III., 1817," contains the following Entomological papers; 1. "On the characters of Matuta, with descriptions of the species." 2. "Micippa, a new genus of Brachyurous Malacostraca." 3. "Monograph on the genera and species of the genus Leucosia, *Fabr.*" 4. "On the Thalassina of Latreille." 5. "On the genus Atya." 6. "The character of the class Myriapoda, with descriptions of some of the species." 7. "On the character of the class Arachnoïda, and of its families." 8. "On the genera of Scorpionidæ, with descriptions of the British species, of chelifer and obisium." 9. "On the Orders of Insects." 10. "On the Genera of Thysanura." 11. "On the genera of Anoplura." 12. "On the genera of Dyticidæ." 13. "On four genera hitherto called Silpha." 14. "On the Histeridæ." 15. "On the Pselaphidæ." 16. "On the Parnidæ." 17. "On Hydrophilidæ and Helophoridæ." 18. "On the genera of Sphæridiadæ." 19. "On the Tenthedinidæ." 20. "On the Rhipiptera of Latreille."

In the "Mémoires de L'Academie Imperial de St Pétersbourg," we find, 1. "Coleoptera Capensia antennis lamellatis, A. C. P. Thunberg." 2. "Decades tres Eleuteratorum novorum descripsit, J. F. Eschocholtz;" in which five new genera are established.

Vol. I. Part 2. of the "Journal of the Academy of Natural Sciences of Philadelphia," contains a continuation of excellent Memoirs on the Crustacea of the United States, by T. Say, Esq.

The "Journal de Physique" (Vols. LXXXVI. and LXXXVII.) contains, 1. "Recherches sur la Metamorphose du canal alimentaire chez les Insectes, par M. Dutrochet." 2. "Sur une nouvelle espèce de Tenthrède, par M. Bosc." 3. "Sur quelques genres nouveaux de Crustacés, par M. Leach." 4. "Recherches anatomiques sur les Scolies et sur quelques Insectes Hymenoptères, par Leon Dufour." The same work for 1819, Vol. LXXXVIII., contains, 1. "Sur les Rhipiptères de Latreille, ordres d' Insectes nommés Strepsiptera, par Kirby; par M. Leach." 2. "Description de deux nouvelles espèces de Thynnus, découvertes dans la Nouvelle Hollande, par M. Rob. Brown; par M. Leach." 3. "Descriptions, par M. Leach, de quelques nouveaux genres et espéces d'animaux découverts en Afrique, par Mr T. E. Bowdich."

Vol. XII. Part II. of the "Transactions of the Linnean Society" was published in July 1819, although it bears the date 1818. It contains two papers on Insects, by the Reverend W. Kirby; the one is named "a Century of Insects," the other, "Descriptions of several new species of Insects, collected in New Holland by R. Brown, Esq."

"The Entomologist's useful Compendium, &c. by G. Samouelle, London." 8vo. This is a valuable work, and will tend materially to advance the study of British Entomology, since it is arranged after the natural method. It does infinite credit to its ingenious author.

(v.)

INDEX OF AUTHORS' NAMES.

ENTRE-DUERO-E-MINHO, one of the provinces into which the kingdom of Portugal is divided. It is bounded on the north by the river Minho, which divides it from Spain, and on the south by the river Duero. The Atlantic Ocean is its western boundary; and, on the eastern side, a range of lofty mountains separates it from the province of Tras los Montes. It has a much denser population than any other part either of Spain or Portugal. Its extent is 291 square leagues, and in 1798 (the last census) its inhabitants amounted to 907,965.

It enjoys the most fertile soil, the most salubrious climate, and the most beautiful rivulets of any part of the peninsula. Its vegetable productions are wheat, maize, oranges, lemons, figs, and especially wine. The latter is the great object of export, and, indeed, forms the principal trade of the whole kingdom, as almost all the red wine commonly called port, from the place whence it is shipped, is the produce of this province. There are manufactures of hats, of silks, of linens, of sail-cloth, and of woollens, and though not rendered sufficiently cheap to be exported to the other countries of Europe, they supply the domestic consumption, and furnish exports to Brasil and the settlements on the coast of Africa.

The rivers next in importance to those which form the boundaries are the Lima, the Cabado, and the Ave, all of which, aided by the mountains, form natural defences against an invading enemy. Though Oporto, both in population and wealth, is the first city; yet Braga, as the see of an archbishop, is the capital of this province. (W. W.)

EQUATIONS. As we are accidentally prevented from inserting in its proper place, an original and elaborate view of the theory of EQUATIONS, we shall, for the instruction and gratification of our scientific readers, depart so far from our general plan, as to give the article in the form of an ADDENDUM to this volume.

ERNESTI (JOHN AUGUSTUS), one of the most illustrious Philologers and Theologians of the last century. He was born on 4th August 1707, at Tennstadt, of which place his father, likewise a distinguished theologian, was pastor, and superintendent of the electoral dioceses of Thuringia, Salz and Sangerhusen. After having received his first instruction in the learned languages, under the domestic discipline of his father, and in the gymnasium of his native town, he was sent at the age of sixteen to the celebrated Saxon cloister school of Pforta. Here he continued four years. At the age of twenty he entered the University of Wittemberg, where he studied eloquence and ancient literature under the celebrated Berger, theology under Wernsdorf, and the Wolfian philosophy under Schlosser. From Wittemberg he passed to the University of Leipsig, where he applied himself to the mathematical sciences under Hausen, following the courses of Boerner and Deyling on theology, and the lectures of Gottsched on German eloquence. In 1730, he was made Master in the Faculty of Philosophy. In the following year he accepted the office of Conrector in the Thoman school of Leipsig, of which J. M. Gesner was then Rector; and on Gesner's vocation, as professor of eloquence, to Göttingen, he succeeded him as Rector. In this situation, by his erudition, diligence, and the elegance of his methods, he surpassed all his contemporaries, and created an epoch in Germany for the study of the ancient authors. From this office, in opposition to the present custom, which precludes a translation into the universities to the masters of the subordinate schools, he was, in 1742, named as Extraordinary Professor of Ancient Literature in the University of Leipsig, and in 1756, promoted to the Ordinary Professorship of Eloquence. In both these chairs he knew how to combine more intellect, philosophy, and taste, than had been done by any of his predecessors. His reputation as a scholar, and his rational treatment of the biblical exegesis, paved the way to his entrance into the Theological Faculty. Through the elegance of his learning, and his manner

of discussion, he co-operated with Baumgarten of Halle in disengaging dogmatic theology from the scholastic and mystical excrescences with which it was then deformed; and thereby contributed greatly to the new revolution in theology, although he himself never deviated from the ancient system. In these deserving labours, and with unbroken health, he attained an honourable old age; and died, after a short illness, in his seventy-sixth year, on 11th September 1781.

Whether Ernesti be considered as a philologer or theologian, it is perhaps as much from the impulsion which he gave to sacred and profane criticism in Germany, as from the intrinsic excellence of his own works in either department, that he must derive his reputation. With Gesner, he instituted a new school in ancient literature; and after Crocus, Melancthon, and Camerarius, has been perhaps the greatest reformer and promoter of classical learning in Germany. With Semler he partially co-operated in the great revolution of Lutheran theology; though he is guiltless of all participation in the deductions which many of those who profess themselves his disciples, have drawn from the principles which he established.

An enthusiastic and enlightened study of the ancient Greek and Roman authors is the well-merited boast of the present German literature. This commenced, in its existing form, towards the middle of the last century. Not that Germany, before that period, had neglected ancient literature, or could not enumerate her proportion among the great names of classical erudition. No nation, in fact, had produced so many, or more illustrious, scholars immediately after the Reformation; but for a long time polite literature had become deformed, if not neglected, in proportion as religious wars and polemical theology had exhausted and engrossed her governments and universities. The German scholars were chiefly theologians; and theologians who had studied everything in reference to their peculiar profession. Add to this, that the most disgusting and inefficient methods had been introduced; whereby the spirit of the instruction was at utter variance with the object of the study. Accordingly, during the whole of the seventeenth and the first half of the eighteenth century, Germany was far excelled by Holland in the number and excellence of her philologers; and it was not until the appearance of Gesner and Ernesti, with their somewhat earlier contemporaries, Cortius, Daniel Longolius, and Michael Heusinger, that she could oppose above one or two rivals to the great critics of the Dutch schools. Gesner and Ernesti, however, through the influence of their lectures at the greater universities of Göttingen and Leipsig, through the wider extent of their labours in philology, and still more through the greater excellence of their methods, are alone entitled to be held the founders of the new German school of ancient literature. Both excelled their philological countrymen in taste, in the elegance of their Latin style, in a philosophical spirit, and in a wider acquaintance with the subsidiary branches of erudition. Both made an advantageous use of their critical knowledge of the languages; both looked at once to the words and to the subject of the ancient writers; established and applied the rules of a legitimate interpretation; and carefully analysed the meaning as well as the form of the expression. Both contributed effectually to expel the old absurd, and disgusting methods of instruction from the schools and universities, and to introduce an improved and more effectual system. To the epoch which they formed, many circumstances indeed contributed:—their acquaintance with the Dutch criticism; the universal enthusiasm of the Germans for establishing a national literature, and for becoming, at the same time, reformers in the departments of ancient learning; and withal the spirit of philosophy which at that period, in Germany, began more and more to blend itself with every part of science and literature. It is also true that their editions do not possess the complement of erudition and criticism which distinguish those of many of their contemporaries: their commentaries have the precision, but how inferior are they in certainty copiousness and depth of illustration, to those of the philologers of Holland? In their editions of the Latin classics, they returned back to the somewhat inconvenient method of Cellarius, collecting their principal illustrations into an *Index Rerum et Verborum*, as is done by Gesner in his *Quintilian*, and by Ernesti in his *Cicero*; not, however, that they did not possess the means of illustrating their author with a rich critical and philological commentary; of which the former has given ample proof in his editions of the *Scriptores de Re Rustica*, and in his *Claudian*, the latter in his two most valuable labours, his *Suetonius* and *Tacitus*. Both, but especially Ernesti, have detected grammatical niceties in the Latin tongue, which had escaped all preceding critics; such, among others, are the use of the subjunctive mood after the pronoun *qui*, and the legitimate consecution of the tenses. His canons are, however, not without exceptions. As an editor of the Greek classics, Ernesti deserves hardly to be named beside his Dutch contemporaries Hemsterhuis, Valkenaer, Ruhnken, or his colleague and enemy, the learned and unfortunate Reiske. How insignificant are his own labours in his editions of Homer and Callimachus? In regard to the higher criticism, it was not even attempted by Ernesti. But to him and to Gesner, the peculiar praise is owing, of having formed, partly by their discipline and partly by their example, philologers greater than themselves; and to them is due the honour of having so strongly excited in Germany that enthusiasm for ancient learning, which has now, unfortunately, no parallel in the other countries of Europe.

As a theologian, Ernesti is far less conspicuous than as a scholar, and his influence not so marked either on his contemporaries or on his successors. Before the middle of the eighteenth century, the Spenerian pietism had been almost banished from the Lutheran theology; and the professors of that faculty in the Protestant universities of Germany no longer excluded philosophy from all interference in the doctrine of Christian belief. It had then been boldly proclaimed and maintained with pre-eminent ability by Semler, that Luther had commenced and not finished the Reformation of religion; but that this Reformation must still proceed, and that religion,

like other branches of knowledge, must become purer and more perfect, in proportion to the increase of knowledge, and the developement of the human mind. At this date, accordingly, the theologians of Germany had begun to disregard the nonconformity of their doctrines with the Formula of the Lutheran church; and after this period, few were at all apprehensive of openly controverting its tenets, when at variance with the results of their own speculations. From the unrestrained freedom of thought in matters of religion, which was now indulged, if not even encouraged, by the governments in their different universities, every one was at perfect liberty, without any derogation from his character as a clergyman, or instructor, to maintain and promulgate what opinions in religion he chose; and it must be acknowledged, that the theologians have made, and are still making, every use and abuse of this licence, and have arrived at every conclusion that piety and learning, as well as presumption, folly, and irreligion, can suggest. It was at the commencement of this important era that Ernesti flourished as a theologian.

Of the three sciences subsidiary to theology, philosophy, history, and the grammatical exegesis, the first had been imperfectly applied, and without any interesting result, by Baumgarten, a scholar of Wolf; but the second, the historical interpretation, had, in the hands of Semler, been productive of conclusions subversive of much that had been hitherto held orthodox and even sacred. In the grammatical interpretation of the New Testament some imperfect progress had been made by Bengel; but the new epoch in the biblical exegesis commences with John David Michaelis for the Old, and with Ernesti for the New Testament. It is, indeed, chiefly in *hermeneutic* that Ernesti has any claim to the character of a great theologian. But here his merits are distinguished, and, at the period when his *Institutio Interpretis N. T.* was published, almost peculiar to himself. He applied himself to the interpretation of the Sacred Scriptures, after a long and familiar acquaintance with the Greek and Roman writers; and when formed in his mind and taste by a constant study of these patterns. His interpretation of the New Testament bears the character of both these circumstances. It is not only the matter, but at the same time, the manner, in which it is conveyed; it is the selection of subjects, with the precision, the pregnant brevity, the elegance and simplicity in which they are expressed, that confers on this little book so high and so singular a value. We find in it the principles of a general interpretation, and this without the assistance of any particular philosophy, not even of the Wolfian, to which Ernesti was attached; but consisting of observations and rules, which, though already enunciated, and applied in the criticism of the profane writers, had never rigorously been employed in the biblical exegesis. He admits in the sacred writings only *one acceptation*, and that the *grammatical*, convertible and the same with the *logical* and *historical*. The Scriptures, therefore, having this in common with all other writings, it follows that they can only be explained like mere human compositions; that the rules of interpretation are the same in both; and that only through some peculiar constitution of speech and writing could any possible distinction between these subsist. He therefore justly censures the opinion of those who, in the illustration of the Scriptures, refer every thing to the illumination of the Holy Spirit; as well as that of others who, in contempt of all knowledge of the languages, would explain words by things, and thus introduce into the holy writings their peculiar glosses and opinions. The *analogy of faith*, as a rule of interpretation, he greatly limits; and teaches that it can never alone afford the explanation of words, but only determine the choice among their possible significations, and must always stand in need of philology as an assistant. The spirit of Ernesti's interpretation gives no countenance, however, to the results which many of his followers have deduced from the grammatical and historical exegeses. Every principle of his interpretation rests on the assumed inspiration of the holy books; and there is not perhaps a better antidote to the poisonous tenets of many of those who profess to be of his school, than the diligent study of his *Interpres*, and the relative *Acroases* of Morus. In the higher criticism of the sacred books Ernesti did nothing. In dogmatic he always expressed great contempt of strict systematic theology; and though he lectured for many years on the Aphorisms of Neumann, it was rather in refutation than in support of his text-book.

Among his works the following are the more important:

I. IN PROFANE LITERATURE:

Initia Doctrinæ Solidioris, 1736, 8vo: many subsequent editions. A work not only valuable by reason of the real excellence of the matter, but more particularly deserving an attentive study, on account of the purity of the Latin, in discussing subjects of philosophy known only to the moderns.

Initia Rhetorica, 1730.

Xenophontis Memorabilia Socratis, cum notis, 1737; often reprinted.

Ciceronis Opera cum clave. 1737, 2d Edit. Halæ, 1757, 3d Edit. Ibid. 1776, 8vo, 6 vols.

Suetonius cum Animadversionibus, 1748. 2d Edit. 1775–8.

Taciti Opera cum notis J. Lipsii, Jo. Fr. Gronovii et suis, 1752. 2d Edit. 1772. 8vo. Another edition, with many additions and improvements, has been procured by Oberlin.

Aristophanis Nubes cum Scholiis Antiquis et præfatione, 1754. 8vo.

Corradi Quæstura cum præfatione, 1754. 8vo. See Wyttenbach in his *Vita Ruhnkenii.*

Hederici Lexicon Græcum, multis Vocabulorum millibus Auctum. 1754–67. 8vo.

Homeri Opera Omnia, ex Recensione, et cum Notis Sam. Clarkii, accessit Varietas Lectionum MS. Lips. et Edit. Vet. cura J. A. E. qui et suas Notas adspersit. 1759–64. 5 vols. 8vo.

Callimachi Hymni et Epigrammata, cum Notis Var. Latine vertit atque Notas adjecit. Lugd. Bat. 1761. 8vo. 2 vols.

Polybius cum Notis Var. Præfationem et Glossarium Polybianum adjecit. Viennæ et Lips. 1764. 3 vols. 8vo.

Ernesti || Essexshire.

Archæologia Litteraria, 1768. A new and improved edition by Martini.

Horatius Tursellinus de Particulis, 1769. 8vo.

Fabricii Bibliotheca Latina nunc melius delecta, rectius digesta et aucta. Vol. I. and II. 1773, Vol. III. 1774, 8vo; unfinished. The learned Professor Beck of Leipsic has recently announced that he is soon to publish a fourth volume to complete the edition.

II. In Sacred Literature:

Antimuratorius sive Confutatio Disputationis Muratorianæ de rebus Liturgicis, 1755–58.

Neue Theologische Bibliothek. Vol. I. to X. 1760–69. 8vo.

Institutio Interpretis Nov. Test. 1761. Reprinted in the same year at Leyden. 2d Edit. 1765. 3d Edit. 1775. 8vo.

Neueste Theologische Bibliothek. Vol. I. to X. 1771–75. 8vo.

Besides these he published above a hundred smaller works in the form of Prefaces, Academical Dissertations, Programmata, Memoriæ, Elogia, Epistles, Orations, Translations, &c. Many of these have been collected in the three following publications: *Opuscula Oratoria*. Lugd. Bat. 1762. 2d Edit. 1767. 8vo. *Opuscula Philologica et Critica*. Lugd. Bat. 1764. 2d Edit. 1776. 8vo. *Opuscula Theologica*. Lips. 1773. 8vo.

ESSEXSHIRE is bounded on the south by the River Thames, on the east by the German Ocean, on the north by the counties of Suffolk and Cambridgeshire, and on the west by Hertfordshire and Middlesex. Its surface contains 1473 square miles, according to the recent measurement of the Board of Ordnance. The population, which, by the census of 1801, amounted to 226,437 inhabitants, had increased in the succeeding ten years to 252,473; which, on 942,720 acres of land, gives nearly one human being to three acres and three-quarters; but as the rivers and estuaries form a portion of the county, the inhabitants may be calculated at one to three acres and a half.

Essex may be considered as a mere agricultural county; for though, from the near approach of one part of it to the metropolis of the kingdom, there are some manufactories established, which find both their raw materials and their consumption in London, and though in one district of the county there are remains of the once extensive manufactories which were brought from Flanders to this island, the number of persons occupied in them bears but a very small proportion to that part of the population which depends on agriculture.

Oyster Fishery.

Although nearly half the county is bounded by the sea, or by navigable rivers, it carries on no foreign commerce, and what vessels belong to it are employed, either in conveying to London the produce of its agriculture, or in the oyster fishery, which occupies a considerable tonnage and many seafaring persons. The oysters are bred in both the rivers Coln and Crouch, in the former they are protected by the seniorial rights of the corporation of Colchester, and in the latter by the proprietor of that river, Sir Henry Mildmay. The spawn is deposited in the months of April and May; and it is said the shell about it begins to form within twenty-four hours. The fishermen are forbidden to dredge for them at this season. In the month of July the dredgers separate the small oysters from the stones on which the spawn was deposited, and on which they have grown, and lay them down in the channels of the river till they grow of a fit size for consumption, which is determined by a gage, kept for that purpose by the water-bailiff of Colchester. The stones or other substances to which the young oysters had adhered, are again thrown into the water from whence they were taken; as they apprehend the accumulation of the ouse at the bottom of the river would otherwise generate such an increase of muscles and cockles as would destroy the breed of oysters. The number of vessels of different sizes employed in this branch of industry, from ten to forty tons burden, amounts to near three hundred, and the quantity of oysters, varying in different years, which are caught, are from 18,000 to 24,000 bushels. The larger description of vessels are employed, part of the year, on the shores of Hampshire and Dorsetshire in dredging for the native oysters, which are afterwards deposited in the beds of Essex and Kent, to fatten for the London market. The uncertain produce of the breeding grounds in Essex makes it necessary to have recourse to the more distant coasts to obtain the requisite supply.

Essexshire.

Distribution of Population.

From being almost wholly an agricultural county, the far greater part of the inhabitants of Essex are found in villages. The principal places with their population, according to the late census, is as follow:

Colchester, - - -	12,544
Chelmsford, - - -	4649
Walthamstow, - - -	3772
Harwich, - - - -	3732
Saffron-Walden, - -	3403
Halsted, - - - - -	3279
Romford, - - - -	3244
Malden, - - - - -	2679
Bocking, - - -	2544
Coggeshall, - - -	2471
Barking, - - -	2421
Witham, - - - - -	2352
Braintree, - - -	2298
Waltham Abbey, - -	2287
Dunmow, - - -	2279

The towns of Thaxted, Harlow, Epping, Dedham, Billericay, Brentwood, Rochford, Manningtree, Burnham, and Greys, contain each from 1000 to 2000 inhabitants.

Manufactures.

The woollen manufactures are confined to Colchester, Bocking, Halsted, and Coggeshall. The Flemings originally introduced the art of making woollen cloths into this country, and it soon spread from hence, first to the districts nearer to parts producing the wool, and more recently to those where fuel is most abundant. What remains now is principally the manufacture of baizes, some of which are sent to Devonshire, where they are spotted, finished, and exported; but the greater portion is a kind made of the long wool of Lincolnshire, very stout, shaggy, and broad, known by the name of South Sea baize. These are sent to London white, and are there dyed to some of the most expensive colours, so that the

Essexshire. cost of dyeing and finishing frequently amounts to more than the price of the baize. They are generally exported to Spanish America, formerly through the peninsula, but recently direct, and they form the clothing of the inhabitants of the cold regions of the Andes. A kind of stuff called Says is likewise made here, which, like the baize, is commonly dyed and finished in London, and is exported to Spain and Italy, where it is adopted for the dress of the clergy.

The manufactures are, however, rapidly declining, and will probably, in a few years, become extinct. The improvements in machinery, the fine streams of water for turning mills, and the low price of fuel, have created a competition in the northern counties with which it is not possible that Essex can long contend. On the eastern side of the county, contiguous to London, there are some establishments for printing calicoes and for bleaching. There are also manufactories of sal-ammoniac, of Prussian blue, of iron liquor for the calico printers, and some other chemical preparations.

Forests. The face of the county is generally very beautiful; it is well inclosed; for the most part displays good verdant pastures; the hills, none of which rise to great heights, are cultivated to the tops, and there are abundance of trees, especially oak and chesnut, which give a rich appearance to the prospects. There is no county in England in which the proportion of waste land is so small. The forests and wastes can indeed scarcely be considered as utterly uncultivated, and the whole of them do not amount to more than 14,000 acres, including the two forests of Epping and Hainault. These belong to the crown; though the inhabitants of many surrounding parishes have the right of pasturage for their cattle upon them. The king has an unlimited right to keep deer on all the inclosed woods, and the occupiers of land, in the various parishes included within the ancient boundaries of the forests, have a right to feed horses and cows, but no other cattle. The numerous common rights have led to considerable devastation of the timber of these forests, and considerable injury to the property of the crown, but plans have been lately adopted for preserving the trees, and converting a part into a nursery for growing timber for the royal navy. The vicinity to navigation makes these forests well deserving to be appropriated to this purpose.

Soil and Culture. That part of Essex which lies on the banks of the Thames, and on the shores of the ocean, is a rich alluvial soil on a subsoil of very tenacious clay. It produces, with good cultivation, most abundant crops of wheat, beans, oats, and clover. It is found necessary on the cultivation to fallow very frequently, and repeated ploughings is a practice very generally adopted. The swing-plough is much used, and sometimes a wheel-plough drawn by two, and occasionally by three horses a-breast, which are guided with long reins by the ploughman. In fallowing it is common to plough the land six or seven times, and it is not unusual with the best cultivators to plough it eight or even ten times. After the summer fallow, by which the soil becomes completely pulverized, and rendered as fine as a garden, it is sometimes the practice to sow wheat in the autumn, but it is more common to let it remain through the winter; and then, after a spring ploughing, to sow barley or oats. The rotation of crops which usually succeeds to a fallow is, 1. Barley or oats; 2. Clover, red or white, mostly the former; 3. Wheat; 4. Beans, twice hoed at least; 5. Wheat. After this course the land is again fallowed. The whole produce of the course of crops is said to depend on the accuracy and skill exercised in the process of fallowing.

There is in this district some land adapted for turnips, and the rotation on such soils is usually, 1. Turnips; 2. Oats or barley; 3. Clover; 4. Wheat; 5. Beans; 6. Wheat. These courses are occasionally varied, tares being introduced when the clover fails, and sometimes pease being substituted for beans. The best cultivators often omit the second crop of wheat, and fallow again after the beans. A rotation which is sanctioned by some very skilful agriculturists is the following: 1. Fallow; 2. Barley or oats; 3. Clover; 4. Beans; 5. Wheat; 6. Tares or pease; 7. Wheat. In this case the manure is laid on the clover ley for the bean crop. In the district we are describing all the farms have a portion more or less extensive of rich marsh land, on which oxen are fed, which supplies hay for winter consumption, and is consequently the source from whence the manure is derived. The best wheat that is brought to the market of the metropolis is raised in the part of Essex of which we are speaking, which is usually denominated the *hundreds*. It has the convenience of water-carriage to London; the rent of land is comparatively low, and it is of extraordinary fertility; but it suffers from a scarcity of good water. It is, especially in the autumn, a very agueish country; and though, of late, the roads have been much improved, they are still in such a state as, added to its insalubrity, prevents the gentry from residing on their estates.

The middle part of Essex rises above the level of the marshy lands, but partakes, in a considerable degree, of their unhealthiness. Around the town of Colchester, for a considerable distance, the soil is a dry loam, well calculated for turnips, and then the most general system adopted is the four course husbandry of Norfolk, viz. turnip, barley, clover, and wheat. A variation is, in some instances, introduced by taking a crop of pease after the wheat, and occasionally tares are sown after the barley instead of clover, as that latter plant will sometimes fail, if too frequently repeated. The greater part of the district is, however, of a clayey loam, on a subsoil of clay, and too tenacious for the turnip system. Much of this is good old pasture land, used solely for feeding, and to which the plough is never applied. The arable land is highly productive; the crops of wheat and beans especially are very luxuriant, and their produce of the best quality. The practice of fallowing is pursued as in the district before described, but so many ploughings are not deemed to be necessary. The rotation is various, but it rarely occurs that wheat is sown immediately after the fallow. Most commonly the succession is, 1. Fallow; 2. Barley; 3. Beans; 4. Wheat; 5. Tares; 6. Barley; 7. Clover. When the land is more wet, which, in spite of excellent draining, is frequently the case, the ro-

Essexshire. tation is, 1. Fallow; 2. Oats; 3. Clover; 4. Wheat. When manure is abundant the heavy soils are cropped in the following rotation with great success: 1. Fallow; 2. Beans; 3. Wheat; 4. Tares; 5. Barley; 6. Clover; 7. Beans; 8. Wheat. In this rotation, the clearing the ground from weeds depends on the use of the hoe, which is applied most carefully to the crops of beans.

The western part of the county, especially where it borders on Hertfordshire, is, in general, land of a very inferior quality, and, without most expensive cultivation, yields but light crops. One extensive district, called the Rodings, still practises a most singular system of husbandry, known now in Essex only, though formerly it was adopted on poor lands in some other counties. It is, 1. A year's fallow, 2. Wheat, 3. Fallow, 4. Barley, and then repeat the same course; thus having one-half the arable land constantly without any crop. The soil is a tenacious clay, of a reddish colour, upon a subsoil of white clay. It is difficult to pulverize, and, with wet, potches so much as not to admit of ploughing when the atmosphere is moist. There are but small parts of this district which produces clover, pease, tares, or beans, and what hay is grown is confined to the narrow borders of the rivulets which run in the valleys.

In the south-western part of the county, the agriculture assumes that system which is adapted to the supply of the wants of the metropolis. A great portion of the land is in permanent pasture, or grows hay to furnish the markets of Smithfield and Whitechapel. The arable land is generally cultivated with a rotation of three crops, viz. potatoes, wheat, and clover; and, as London supplies abundance of manure, by applying it very liberally to the young clover, after the wheat is harvested, such culture produces most abundant crops, and the land is cleaned by the potatoe culture. In this kind of husbandry, which, indeed, can only be conducted where manure is to be obtained with great facility, the plough is only used once in the rotation, after the clover; as the potatoes are planted, and the digging them up sufficiently prepares the land for wheat.

Cattle. Essex feeds some sheep, but very few are bred in the county. Calves are suckled to a great extent, and the rearing them to furnish veal for the London market is the principal dependence of many farmers. The whiteness of the veal is produced by a great attention to cleanliness, by regular periods of suckling, and by giving them a small portion of barley-meal mixed with chalk. The tendency to fatten is promoted by administering narcotic drugs, which keep the young animals in a quiescent state. Though the county affords such abundance of excellent pasture, yet the fattening of calves is so much more profitable than the dairy, that it is supplied with butter from other counties. Epping has indeed been celebrated for its excellent butter; but the greater part of what is sold in London under that denomination is the produce of Northamptonshire, Buckinghamshire, and other counties. London is supplied with much of its beef from Essex. The bullocks, in a lean state, are brought from Scotland, from Wales, and some from Devonshire, and are fattened in this county, sometimes on the rich, natural meadows, and sometimes on turnips, with the addition of oil-cake. Essexshire.

Several other agricultural productions are cultivated in Essex. Hops are grown near Chelmsford, and in a few other districts. Saffron is cultivated near Saffron Walden with great success. Mustard is an advantageous crop in the islands of Foulness and Wallasea, and on the embanked marshes. On some rich old pasture land, when first broken up, three crops are raised together, viz. carraway seed, coriander seed, and teasels, for the baize manufacturers. The three kinds of seed are sowed together, in the spring of the year. The harvest of the coriander takes place in the following autumn. The carraway is a biennial plant, and the seed is fit to be gathered in July of the succeeding year; and, in September of the same year, the teasels are cut. The carraway sometimes produces a crop a second, or even a third year. This cultivation is deemed an excellent preparation for the growth of wheat, on lands which are so prolific as to require some degree of exhaustion; as, in the process of this treble cropping, the hoe is very liberally applied, it keeps the ground free from weeds. There are few counties in England, taking the whole of them together, in which the agriculture is so skilfully conducted, or where the productiveness is so great.

The landed property in Essex, as in other counties near to the metropolis, is very much divided; there are no overgrown estates, though some of considerable value, belonging to a few individuals; but the greater part is in moderate-sized farms, which can be easily disposed of, and which are frequently purchased from the savings of the commercial class in London. Size of Estates.

The only good harbour in this county is Harwich, whence the packets for Holland are dispatched, and where there is a royal dock-yard, in which some frigates are built and repaired. The river Coln is navigable for small vessels to Colchester, and the Blackwater river to Walden. The Crouch is navigable for the largest ships, but passing through an unhealthy country, and having few inhabitants on its borders, it is useless to the purposes of commerce. The river Lea is navigable by barges a distance of 25 miles. There are no canals in this county, but one is projected, to unite the river Lea with the Cam, and thus create internal navigation from Lynn to London. Rivers.

The seats of noblemen and gentlemen in this county are very numerous, especially on the western side of it, where it approaches to the metropolis, and where many of the richer citizens have fixed their country residences. The most remarkable are, Audley End, belonging to Lord Braybrooke; Braxted Lodge, Peter Duncane, Esq.; Copped Hall, John Conyers, Esq.; Dagenham Park, Sir Thomas Neave; Easter Lodge, Viscount Maynard; Felix Hall, Charles Western; Gosfield Hall, Marquis of Buckingham; Hallingbury Place, John Houblon, Esq.; Hill Hall, Sir William Smith; Langlees, William Tuffnell, Esq.; Mistley Hall, F. H. Rigby, Esq.; Moulsham Hall, Sir H. C. St John Mildmay; Roydon, Sir George Duckett; Terling Place, John Strutt, Esq.; Thorndon Hall, Lord Petre; Wansted

House, Hon. William Pole Tylney Long Wellesley; Weald Hall, Christopher Towers, Esq.; Bell House, Sir Thomas Lennard; Whitley, Thomas Walford, Esq. The family of Capel derive the title of Earl from this county, that of Nassau from the town of Rochford; and Mr Abbot, late Speaker of the House of Commons, has been created Lord Colchester.

See Morant's *History and Antiquities of Essex*—Dale's *History of Harwich*—*History of Essex*, 8vo, 1769, ascribed to Bate Dudley—Arthur Young's *Survey of Essex*—Brayley and Britton's *Beauties of England and Wales*—Lyson's *Environs of London*.

(W. W.)

EUROPE.

Comparative Advantages and Disadvantages of this Division of the Globe.

One of the great divisions of the globe. On a first view, Europe appears to be less favoured by nature than the other quarters of the globe over which it has obtained so great an ascendancy. It is much smaller in extent; its rocky and mountainous surface does not admit of those noble rivers, like inland seas, which lay open the remotest regions of Asia and America to the commerce of the world. Its vegetable productions are neither so various nor so exuberant; and it is poorly supplied with the precious metals, and with many of those commodities on which mankind set the greatest value. On the other hand, the climate of Europe, if it nourishes a less luxuriant vegetation, is of an equal and temperate kind, well adapted to preserve the human frame in that state of health and vigour which fits it for labour, and promotes the developement of the intellectual and moral powers. The mountains that intersect its surface were barriers which enabled infant communities to protect themselves from violence, and to lay the foundation of arts, knowledge, and civilization. If it has few large navigable rivers, its inland seas and bays are the finest in the world, and were the means of creating and nourishing that commercial spirit which has been one great source of its improvement. Though comparatively deficient in gold and silver, it is abundantly supplied with those useful metals and minerals which minister still more essentially to the wants of civilized life. Its apparent defects have become the source of real benefits, and the foundation of its grandeur. The disadvantages of its soil and climate have excited the industry of its inhabitants, given them clearer ideas of property, kindled a resolute spirit to defend their rights, and called into existence that skill and enterprise, and those innumerable arts and inventions, which have enabled the inhabitants of this apparently barren and rocky promontory to command the riches and luxuries of all the most favoured regions of the globe. It is only in Europe that knowledge and the arts seem to be indigenous. Though they have appeared at times among some of the nations of Asia, they have either stopt short after advancing a few steps, or they have speedily retrograded and perished, like something foreign to the genius of the people. In Europe, on the contrary, they have sprung up at distant periods, and in a variety of situations; they have risen spontaneously and rapidly, and declined slowly; and when they disappeared, it was evident, they were but crushed for the time by external violence, to rise again when the pressure had subsided. It is only in Europe, and among colonies of Europeans, that the powers of the human mind, breaking through the slavish attachment to ancient usages and institutions, have developed that principle of progressive improvement of which it is impossible to calculate the final results. The rudest tribe in Europe, in which this principle has taken root, has a certain source of superiority over the most improved nations of Asia and Africa, where society remains perfectly stationary. If these nations are ever destined to advance in civilization, they must borrow from Europe those arts which she has invented, and which belong to civilized life in every climate. But the tenacious adherence of rude nations to the customs and superstitions of their ancestors will not allow us to hope that the benefits of civilization will be rapidly diffused in this way. It is more probable, that colonies from the older states of Europe will multiply, as the population becomes more and more redundant; and that these colonies will carry the arts and knowledge, the language and manners of Europe with them, to the other quarters of the world. From prejudices on both sides, it is found that two races in very different stages of civilization do not readily amalgamate; and it is therefore probable, that the feebler inhabitants of these countries, like the American Indians, will be gradually displaced by the continued encroachments of the more energetic race of Europe. Such a change, however, must take place slowly, and there is nothing in it to alarm humanity. The vast number of tribes that people Asia and Africa seem born only to be the victims of savage superstition and ferocious tyranny. No treatment they are likely to experience from European colonies can render their condition worse; and were the whole swarm of these nations to die out in the course of nature without being renewed, no great deduction would be made from the sum of human enjoyment. Should the state of things we have been contemplating, and which seems to arise naturally out of the circumstances of Europe, and the other quarters of the globe, be realized, it will be curious to reflect on the circle of changes which will then be completed. The ancient inhabitants of Europe, as well as the modern, were originally colonies sent off from the surplus population of Asia. Here they have thrown off their barbarism, invented and improved arts and sciences, and carried their social institutions to a high degree of perfection; and now, in the maturity of their strength, they are throwing back their surplus numbers upon Asia, to conquer and supplant the remains of those tribes from whom they originally sprung.

Boundaries and Extent.

Europe is bounded on the north and west by the Arctic and Atlantic Oceans; on the south by the

Europe.

Mediterranean; on the east by the rivers Don, Wolga, and Kama, and by the Uralian Mountains from the Kama to the Arctic Ocean. These are the limits most generally admitted. Some alterations have been proposed on the south-east side, with the view of making the boundary line correspond more accurately with the physical divisions of the earth's surface; but as they have not obtained the sanction of geographers generally, the line that is best known seems entitled to the preference. The greatest length of the Continent of Europe is from Cape St Vincent to the Sea of Kara, in the direction of north-east and south-west, and is 3490 English miles. Its greatest extent from north to south is from Cape Matapan to Cape North, 2420 miles. Its greatest extent from east to west is on the parallel of 48°, from Brest to River Don, 2230 miles. The superficies of Europe, including the Azores, Iceland, Nova Zembla, and all the other islands belonging to it, is 3,432,000 English square miles.

Climate.

The climate of Europe is distinguished by two peculiarities. It enjoys a higher mean temperature than any of the other great divisions of the world, in the corresponding latitudes; and it is not subject to such violent extremes of heat and cold. These advantages it owes chiefly to its numerous seas, inland bays, and lakes, which render its temperature similar to that of islands; and partly also, according to Humboldt, to its situation at the western extremity of the greatest range of dry land on the surface of the globe; the western sides of all continents being warmer than the eastern. Europe lies almost entirely within the temperate zone, not more than one-fourteenth part of its surface being within the arctic circle. Only a very small part of it is uninhabitable from cold, and it nowhere suffers much from excessive heat. The mean temperature at its southern extremity, in the latitude of 36°, is about 66° of Fahrenheit; and at Cape North in the latitude of 71°, where the mean temperature is 32°, the cold is not greater than in the latitudes of 55 or 56 on the east coasts of Asia and America. Hence Europe is habitable at a higher latitude by 12 or 14 degrees than either of these continents. The following table, taken from Humboldt's *Memoir on the Distribution of Heat* (abridged in Dr Thomson's *Annals of Philosophy*, XI. 188), shows the difference in temperature between Europe and the eastern shores of Asia and America at the parallel of 40°: the difference is much greater at the parallel of 60°.

	Lat.	Mean Temperature of the Year.	of 3 Winter Months.	of 3 Summer Months.
Rome, -	41.35	60.4	45.8	75.2
Pekin, -	39.54	55.2	26.8	82.6
New York,	40.40	53.8	29.8	79.2

There is a difference of the same kind between the temperature of the sea-coasts of Europe and the interior. In islands, and on the sea-coast, the mean temperature of the year is higher, and the heat is more equally distributed through the different seasons. As we advance from the coast eastward the mean annual temperature diminishes, but the heat of summer and the cold of winter increase. Thus London has the same mean annual temperature as Vienna, but it has the summer of Petersburgh, and the winter is warmer than at Milan. The Mediterranean, the Baltic, and inland lakes, produce the same effect as the ocean in an inferior degree. The two following tables are taken from Humboldt (*Annals of Phil.* XI. 188); the first shows the temperature of the year, and the various seasons in places having the same latitude; the second shows the different distribution of heat through the various seasons in places having the same mean annual temperature.

PLACES.	Mean Temperature of the Year.	Winter.	Spring.	Summer.	Autumn.	Warmest Month.	Coldest Month.
I. *Lat.* 56.							
Edinburgh, *	47.8	38.6	46.4	58 2	48.4	59.4	38.3
Copenhagen,	45.6	30.8	41.2	62.6	48.4	65.0	27.2
Moscow,	40.[illegible]	10.8	44.[illegible]	67.1	38.3	70.6	6.0
Lat. 48.							
St Malo,	54.4	44.2	52 2	6.0	55.8	67 0	41.8
Vienna,	50.6	32.8	51.2	69.2	50.6	70.6	26 6
II. *Lat*							
Dublin, 53.21	49.2	39.2	47 [illegible]	59 6	50.0		
Prague. 50.5	49.4	31.4	47.6	6[illegible].9	50 2		

Mountains.

The mountains of Europe are more numerous in proportion to its extent than those of the other great continents, but they are of less elevation than the mountains of America and Asia. The highest, and the most extensive chains in Europe, run generally in the direction of east and west, and are placed near its southern shores. The central mass of the Alps, with which all the other mountains in the south of Europe are connected, forms the summit of the continent, and determines the position of the surface, and the course of most of the rivers. From this central point the surface of the land descends to the sea by a series of vallies, skirted by subordinate chains. The three countries to the southward of the Alps and their branches, Greece, Italy, and Spain, consist of mountainous peninsulas projecting into the Mediterranean. The countries to the west, north, and east of the Alps, which present more extensive plains and gentle declivities, are the seats of the three principal monarchies in the south of Europe. Austria, seated on the eastern declivity, rules over the countries watered by the Danube; France occupies the western declivity, and the countries watered by the principal streams that flow to the west; and Prussia the countries watered by the streams that flow to the north. If we descend from the Alps to the sea in a western direction, the first valley we meet with is the level part of Switzerland between the Alps and Mount Jura, elevated from 1600 to 1800 feet above the sea; the second, between Jura and the Cevennes, some hundred feet lower; and the third, and lowest, extends from the Cevennes to

* Copenhagen is about 620 miles east from Edinburgh; Moscow about 1000 miles farther.

Europe.

the Atlantic. In a north and north-east direction, the first valley is Bavaria, the second Bohemia, both of which are completely enclosed by mountains; the third, consisting of Silesia, Brandenburg, and Poland, terminates in the Baltic. In an eastern direction the first valley is Austria, the second, Hungary, both encircled with mountains; the third, Bulgaria, extends to the Black Sea. South from the Alps we have first the valley of Lombardy, and then the narrow coast of Genoa. The vast plain occupied by Russia, and the eastern part of the Swedish peninsula, may be considered as a prolongation of the valley of Prussia and Poland, extending to the Dofrines on the west, the Uralians on the east, and Mount Caucasus on the south. Thus, in a general point of view, the elevation and declivity of the large plains of southern Europe bear a certain relation to the position and distance of the central mass of the Alps.

Alps.

The principal mass of the Alps extends in a semicircle from Nice, on the shores of the Mediterranean, to Trieste, on the Adriatic, a distance of 550 miles. Southward of Mont Blanc, the Alps consist of a single chain, with many lateral branches, which lie chiefly on the west side; but immediately to the eastward of Mont Blanc, the principal chain divides into two, which enclose the sources of the Rhone. These meet, again, at St Gothard, and, on the east side of it, part into three chains, one of which loses itself in Bavaria, another in Austria near Vienna, and the third terminates near Trieste. A lateral chain, of no great elevation, passes eastward, and connects the Alps with the mountains of European Turkey. Smaller branches connect the Alps with the Bohemian and Carpathian mountains on the north, with the Vosges and Cevennes on the west, and, through the latter, with the Pyrenees. The Apennines are but a prolongation of the Alps on the south. Mont Blanc, the loftiest of the Alps, and the highest mountain in Europe, has an elevation of 15,680 English feet; and Mount Rosa, the Jungfrau, the Schreikhorn, and several other summits, approach to this height. The elevation of the chain diminishes towards both extremities. In general, the escarpments, or steepest sides, are turned towards Italy, and the lateral and subordinate branches are most numerous, and extend farthest on the opposite side. The central chain of the Alps consists chiefly of granite, gneiss, sienite, and other primitive rocks. Among the lateral ridges, to the westward of St Gothard, calcareous rocks, with clay-slate and mica-slate, abound on the side of France; on the side of Italy, the ridges are narrower, magnesian rocks abound, and the clay-slate is wanting. On both sides are found great deposits of gravel, and large detached blocks or boulders, often at a vast distance from their original situations. Eastward from St Gothard, the central chain is accompanied on each side by a calcareous chain of great elevation.* Though the summits of the Alps are steep and rocky, and the higher vallies are filled with glaciers, there is much good soil below. The vine grows to the height of 1600 feet above the sea, the oak to the height of 3390, corn to 4200 feet, and the larch to 6720 feet. At 6400 feet above the sea, we have the climate of Lapland, in latitude 68°, so that a degree of latitude, in the northern half of the temperate zone in Europe, corresponds to an elevation of about 290 feet. The inferior limit of perpetual snow, according to Humboldt, is at the height of 8760 feet, in the latitude of 46°. (*Annals of Phil.* II. 373.)

Pyrenees.

The chain of the Pyrenees, which is next to the Alps in elevation, runs in the direction of east and west. Its length is about 240 miles; but, if we include the Cantabrian mountains, which continue in the same line without interruption, the whole length will be about 500 miles. The central chain of the proper Pyrenees is of granite, but the most elevated summits are of secondary limestone, and lie on the south side of the granite. Mont Perdu, esteemed the loftiest of the whole range, consists of fetid limestone, and rises to the height of 11,270 feet. The south side of the Pyrenees is rugged and precipitous; but, on the north, there is a gradual descent to the plains of France by a series of parallel ridges diminishing in height. The Cantabrian mountains are lower than the Pyrenees, and present their steepest sides to the north. There are four other chains of mountains in Spain all running in a direction approaching to east and west, and all connected with one another and with the Pyrenees. The most elevated of these is the Sierra Nevada, the southmost, one of whose summits rises to the height of 11,660 feet. (Laborde, I. 173.) The inferior limit of perpetual snow on the Pyrenees is at the height of 8960. The red pine rises to the height of 7480 feet, which is about 700 feet higher than any species of trees on the Alps.†

Apennines.

The Apennines form an uninterrupted chain 750 miles in length, extending from the south-west termination of the Alps near Nice to the Straits of Messina. The north-west division, which skirts the basin of Lombardy, consists chiefly of greywacké; from Tuscany to near the southern extremity, the prevailing rock is secondary limestone. Granite and other primitive rocks are found at the two extremities in Liguria and Calabria, but are wholly wanting in the intermediate space. The most considerable elevations are about the middle of the chain, where Il Gransasso rises to the height of 9570 feet. (*Edinb. Review*, XXVI. 156.)

Carpathians.

The Carpathian and Sudetic mountains, with the Erzegebirge and Boehmerwald, may be considered as forming one continued chain, the length of which, from the point where it strikes the Danube in Hungary, to the point where it strikes the same river in Bavaria, is about 1200 miles, exclusive of the transverse branches which separate Moravia from Bohemia and Hungary. The declivities of this long range of mountains are steepest on the south side. The elevations are lowest on the west, and generally increase as we advance eastward, till we come to the sources of the Thiess in the north of Hungary, after which they again decline. The Fichtelberg,

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* Mentelle et Malte-Brun, *Geographie*, Paris, 1803-5, VII. 509.

† Mentelle et Malte-Brun, *Geog.* XV. 52.—*Annals of Phil.* VII. 373.

Europe. at the westmost point of the chain, is 4030 feet high; Schnekoppe, the highest of the Sudetic mountains, is 5280 feet, and Lomnitz in Hungary, the loftiest of the whole range, is 8460 feet. None of these mountains rise to the region of perpetual snow, the inferior limit of which, according to Wahlenberg, is about 60 feet above the summit of Lomnitz. The most elevated parts of these mountains consist of primitive rocks; corn and fruit trees are said to grow at a greater height upon the Carpathians than upon the Alps, though the latter are two degrees farther south.*

Dofrines. The chain of the Dofrines, or great Scandinavian Alps, is about 1000 miles in length, and has a general elevation of from 6000 to 6500 feet. The altitude of Snahatta, near the centre of the chain, in latitude 63, is about 8120 feet. (Von Buch's *Travels.*) These mountains consist almost entirely of primitive rocks, and present their steepest sides to the west. On Sulitelma, the highest mountain of this chain in Lapland, in latitude 67.10, the inferior limit of perpetual snow is at the height of 3500 feet.

Urals. The Uralian mountains, which form the boundary of Europe on the north-east, are but imperfectly known. Some of their summits are covered with perpetual snow, but their height is believed not to exceed that of the Scandinavian Alps. They consist chiefly of primitive rocks. The whole length of the chain, which runs nearly north and south, is about 1400 miles, but more than one-half of it is in Asia.

Mountains of Turkey. Of the mountains of European Turkey, we know as little as of the Urals. From a central point, nearly equidistant from the Danube, the Adriatic, and the Ægean Sea, three chains proceed in different directions; one, the ancient Hemus, runs eastward to the Black Sea; a second, north-westward, till it joins the Carnic Alps; and a third, southward through the peninsula of Greece. These principal chains send out many branches, but neither their height, nor their geological structure, is known with any degree of accuracy.

Cevennes. The Cevennes in the south of France extend about 300 miles in length from north to south, and their two most elevated summits, Mont d'Or and Cantal, rise to the height of 6400 and 6100 feet. Mount Jura, between France and Switzerland, has nearly the same elevation. The Vosges, a small chain in the north-east of France, rise nowhere more than 4600 feet above the sea. (Mentelle et Malte-Brun, *Geog.* XVI. 6, 28, 44.)

Mountains of Britain. The mountains of Britain extend with some interruptions over a space of 630 miles, along the west side of the island. They are not placed in chains, but rather in irregular groups, and consist chiefly of primitive and transition rocks. Snowden in Caernarvonshire, the highest mountain in Wales, has an elevation of 3568 feet. Bennevis in Inverness-shire, which rises 4350 feet above the sea, is the highest land in the island. (Jameson's *Geognosy*, 319, 320.)

Volcanoes. There are thirteen volcanoes in Europe, which are all situated in the vicinity of the sea. The most remarkable are, Mount Etna, in Sicily, which is 10,963 feet in height. (Jameson.) Its eruptions happen very irregularly; sometimes 50 or 100 years have intervened between one eruption and another, at other times less than one year. Mount Vesuvius, in Naples, which lies about 200 miles north from Etna, is 3900 feet high. (Jameson.) Its eruptions are less frequent than those of Etna. Stromboli, which occupies an island in the Mediterranean, about 80 miles north from Etna, is the only volcano in Europe that throws out smoke or flames constantly. Heckla is a mountain near the south coast of Iceland, 4900 feet high. (Jameson.) Its eruptions are not frequent. The last was in 1783.

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Rivers. Europe is well watered with rivers, but they are but brooks compared with the mighty streams of Asia and America; and, from the unevenness of the surface, afford, in general, no great extent of inland navigation. The Danube, the largest river that is entirely in Europe, is about 1500 miles in length, and waters a superficies of 370,000 square miles. But the Amazons, though only twice the length of the Danube, waters a surface seven times as large, and equal to four-fifths of the Continent of Europe; and, as the quantity of rain that falls in tropical countries is much greater than in northern latitudes, it is probable, notwithstanding the increased evaporation there, that the Amazons conveys more water than all the rivers of Europe put together. If we divide the length of the Danube into a hundred parts, the length of the principal rivers of Europe, expressed in these parts, will be as follows:

Danube, - - -	100
Wolga (partly in Asia), -	130
Dneiper, - - -	72
Don, - - -	69
Rhine, - - -	49
Elbe, - - -	42
Vistula, - - -	41
Loire, - - -	37
Tagus, - - -	32
Oder, - - -	31
Rhone, - - -	30
Seine, - - -	23
Po, - - -	21
Tiber, - - -	10
Thames, - - -	9

A much smaller proportion of the waters of the European Continent flows into the Mediterranean than the extent of its coasts would lead us to expect. The high mountains that range along the south of Europe, parallel to its shores, from Gibraltar to Constantinople, turn the course of the large streams in an opposite direction. Though the length of the line of coast between the points last-mentioned, without computing minute sinuosities, is 4000 miles, or one-fourth of the circumference of Europe, not more than one-tenth of the waters of this quarter of the globe fall into the Mediterranean. The Black Sea, on the other hand, which presents only 850 miles of coast on the side of Europe, receives one-fourth of its waters. It will be seen, from the subjoined table, that one-tenth part of the waters

* Mentelle et Malte-Brun, V. 8. XVI. 62.—Wahlenberg, in *Annals of Phil.* IX. 140.

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of Europe flow into Asia by the Wolga; that the Black Sea and the Baltic alone receive one-half, while only about one-sixth falls into the Atlantic. If the whole of the river waters of Europe be divided into a hundred parts, their distribution will be nearly as follows:

	Length of Coast in Miles.	Water conveyed by Rivers in parts.
Whole length of the bounding line of Europe, and whole quantity of water, -	16,000	100
Mediterranean, from Gibraltar to Constantinople, -	4000	10
Black Sea and Sea of Asoph,	850	26
The Baltic to the Naze of Norway, - -	3340	25
The Atlantic, from Gibraltar to Cape North, - -	3640	17
The Arctic Ocean, from Cape North to the Sea of Kara,	2200	12
The Caspian Sea (in Asia),	——	10

(*Arrowsmith's Atlas.*)

We are not acquainted with the height of the sources of many of the European rivers above the sea. Those of the Danube, according to Malte-Brun, are from 2100 to 2200 English feet, which gives a fall of one foot and a half *per* mile; but, near the sea, the inclination is less; for, at Buda, 900 miles from the mouth of the river, its height, according to Wahlenberg, is 229 feet, which gives a fall of three inches *per* mile, for the lower part of its course. In general, the rivers of Russia, Poland, and the north of Germany, flow over a more level surface, and are more navigable, than those of the south of Europe. Professor Robison states, on the authority of the Abbe Chappe, that the sources of the Wolga are but 480 feet above the ocean (*Ency. Brit.* article RIVER); but, as the Caspian Sea, in which this river terminates, is found to be 324 feet below the Black Sea (*Ann. Phil.* VIII. 391), this increases the space through which the waters of the Wolga descend to 804 feet, in a course of 2000 miles. The average fall may therefore be about two inches and a half *per* mile.

Islands.

The islands of Europe, including Nova Zembla and Iceland, occupy a space equal to 280,000 square miles, or one eleventh part of the surface of the Continent; and of this space, the area of the British Isles amounts to rather less than one half. The Black Sea is the only large sea connected with Europe, in which there are no islands worthy of notice.

Inland Seas. Mediterranean.

The Mediterranean, the noblest inland sea in the world, forms the southern boundary of Europe, separating it from Africa, and partly also from Asia. It may be considered as the bottom of a vast basin formed by the Pyrenees, Alps, Mount Hemus, Taurus, Libanus, and Atlas. These mountains are every where near its shores, which are consequently narrow and much inclined. Hence there are no such extensive plains as Hungary or Poland near the coast of this sea, and hence also no very large rivers fall into it except the Nile; and, altogether, it receives a smaller quantity of water from rivers than the Black Sea or the Baltic, though six times larger than either. Its length is about 2350 miles; its breadth is extremely various, and its surface (exclusive of the Black Sea) is nearly equal to 1,000,000 of square English miles, or something less than one-third of the Continent of Europe. It is generally of great depth, and its numerous islands, which have uniformly a rocky surface, appear to be the summits of marine mountains.

Baltic.

The Baltic, the greatest inland sea that is entirely in Europe, is about 1200 miles long, of very unequal breadth, and presents a surface of 175,000 square miles, exclusive of islands. It occupies the bottom of another large basin, 850 miles in breadth, and 1400 in length, extending from the Norwegian mountains, on the north and west, to the Carpathians on the south, and to the high lands in which the Dneiper, Don, and Wolga rise on the east. This basin, equal to one-third of the surface of Europe, has a very different character from that of the Mediterranean. The mountains are not very elevated, and are so placed as to leave a large tract of land very little inclined between them and the Baltic, over which, especially on the south side, many considerable rivers flow with a gentle current. Hence the country round the Baltic is much more level than round the Mediterranean; lakes are numerous in the low grounds, from the want of declivity; the sea itself is comparatively shallow, and receiving a much greater quantity of river water, it is much inferior in saltness. The commerce of the Baltic is annually interrupted by the ice, which endures four months in the Gulfs of Bothnia and Finland. The whole of this inland sea has sometimes been frozen over for a short time, but this is rare.

Black Sea.

The Black Sea, which belongs only partly to Europe, is 690 miles long, 360 miles broad, and, including the sea of Asoph, presents a surface of 170,000 square miles, being almost of the same magnitude as the Baltic. It derives four-fifths of its water from Europe, and is curiously distinguished from the other seas of Europe, by its being almost totally without islands.

White Sea.

The White Sea is 450 miles in length, of a very irregular figure, and occupies a space equal to 35,000 square miles. It receives some considerable rivers, but is frozen during six months of the year.

Lakes.

The lakes of Europe are numerous, and are of two kinds; those which lie in cavities at the foot of high mountains, which are generally deep; such as the lakes in the Alps; on the east side of the Norwegian mountains; and among the mountains of England and Scotland; and those which are formed in level countries from the want of a sufficient declivity to carry off the water, such as the lakes in Finland, Poland, and Brandenburg. Four-fifths of the lakes of Europe are in the country round the Baltic.

Soil and Productions.

The soil of Europe has neither the extremes of luxuriance nor sterility which belong to the soil of the other great continents. If it does not yield the rich fruits of tropical climates, it is not deformed by the burning sands of Africa, or the pestilent swamps of America. It does not pour forth its riches spontaneously, but, soliciting the care and the labour of man, it requites his industry with what is

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necessary to supply his wants; and, by exercising and sharpening his powers of mind, gives birth to those arts which place the productions of the most favoured climates at his disposal. Many of the plants which have been domesticated in Europe are natives of distant countries. The vine, the olive, and the mulberry, are said to have been brought from Syria by the Greeks; the Arabians introduced cotton; maize was received from the Indian tribes of America; the walnut and peach come from Persia; the apricot from Armenia; and the sugar-cane from China. There are not very many plants belonging to the tropical regions that absolutely refuse to grow in Europe, but an enlightened economy finds other productions more profitable. Besides sugar and cotton, the banana, the orange, citron, fig, pomegranate, and date, grow in the south of Europe. But the more delicate fruits are confined to southern latitudes, and disappear one by one as we advance northward. And it is worthy of remark, that the zones in which they grow generally follow the lines of equal summer heat, and run obliquely across the Continent in the direction of south-west and north-east. If a line is drawn on the map from Brest to Konigsberg skirting the southern shores of the English Channel, and the Baltic, the zones that limit the growth of different plants run nearly parallel with this line. (Young's *Travels in France*, I. 306.) This holds generally in the south and middle of Europe; but in the extreme northern parts, and especially with regard to plants that require a moderate heat continued for a considerable time, the lines that limit the growth of certain vegetables seem to follow a different course, and decline towards the south as we advance eastward, in consequence of the increasing severity and length of the winter. It is scarcely necessary to say, that the zones, traced as proper for different plants, only mark the limits within which their cultivation is found advantageous. Most of them will grow beyond these limits; but they either require some peculiar advantages of soil or situation, or they are less profitable than other kinds of produce.

Vegetable Productions.

The sugar cane, one of the most desirable tropical plants, grows in Sicily and the south of Spain in the latitude of 37° and 38°. The culture of it, which was once extensive in the latter country, has not been entirely abandoned, even since sugar was procured from the West Indies. Cotton is cultivated in the south of Spain on a small scale, to a greater extent in Sicily, the south-east angle of Italy, and in Greece and its isles, as high as the latitude of 41½°: we find it again a little beyond the eastern limits of Europe, at Astrakan, in the latitude of 46°. * The orange and lemon come to perfection in the west of Europe, only in the countries to the south of the Pyrenees and Apennines, within the latitude of 43° in Spain, and 44° in Italy. The olive does not succeed on the west coast of France in the latitude of 43°, but grows as far north as 44° or 45° on the east of France, and in Italy. Attempts to raise it at Astrakan, in latitude 46°, have not succeeded, on account of the rigour of the winter. The fig and the pomegranate, which accompany the olive in the west of Europe, are found in the Taurida in the east, at the latitude of 46°, where the olive will not grow, a proof that these trees bear the winter cold better. (Young's *Trav.* I. 311; Storch, II. 309.) The climate proper for maize is found to terminate on the west coast of France at 45½°; on the Rhine at 49°; on the Elbe at 50° or 51°. Rice has nearly the same geographical range, but requires a peculiar soil and situation. † The culture of the vine extends as far north as the latitude of 47½° on the Atlantic coast; on the Rhine to 50½°; and on the Oder to 52°. In Russia it grows as far north nearly as 52°, but is not cultivated beyond 50°. (Young, I. 306; Storch, II. 310, 323.) The mulberry generally accompanies the vine. The limits of the culture of the common cerealia are not so well defined, as the necessities of man oblige him to raise corn under the most unfavourable circumstances. In a general point of view, however, the parallel of 57° or 58° may be regarded as the northern limit of the cultivation of wheat in Europe. It is raised as far north as 60° or 61° in Finland, but only in some favoured spots. In Russia, generally, it is chiefly confined to the provinces under the latitude of 57°. (Thomson's *Trav. in Sweden*, 409. Storch, II. 229, 240.) The hardier cerealia, rye, oats, and barley, are cultivated in some sheltered situations on the coast of Norway, as high as the latitude of 69° 55′. But on the east side of the Norwegian mountains, these grains scarcely ripen in the latitude of 67° or 68°; and farther east in Russia, it has been found impossible to carry cultivation of any kind beyond the latitude of 60° or 62°. Barley, which accommodates itself better than any other grain to these high latitudes, by shortening the period of its growth, is sown and reaped within the space of seven or eight weeks. But the introduction of potatoes promises to be of vast advantage in these cold regions, as this plant thrives and yields a produce of thirty or fifty fold in places where grain often will not ripen. ‡ Peaches and apricots succeed with much care as far north only as the latitude of 50° in Russia; melons as far as 52°. The plum and the cherry grow wild as far north as 55°, but are carried farther by cultivation. (Storch, II. 302, 304, 308.) Fruit trees and the oak terminate in Sweden, at Geffle, in the latitude of 61°; but the pine and the birch advance within the arctic circle; and the former grows to the height of sixty feet in the latitude of 70°. (*Annals of Phil.* VII. 382.) The black-berry and the whortle-berry grow in Lapland, and the gooseberry even in Greenland. (Mentelle et Malte-Brun, *Geog.* I. 502.) Tobacco is extensively

* Laborde's *View of Spain*, II. 122–125. Storch, *Tableau de la Russie*, II. 250. Mentelle et Malte-Brun, X. 122.

† Young, I. 306; Malte-Brun, *Precis*, II. 508; MS. Travels in Germany.

‡ Storch, II. 209, 244, 304, 370; Von Buch. *Ed. Rev.* XXII. 163, 171; Crome, *Allgemeine Ubersicht, der Staatscraft von den Samtlichen Europaischen Reichen und Landern*, 1818, p. 108; Malte-Brun, *Precis de la Geographie Universelle*, 1812, II. 508.

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cultivated over the greater part of the Continent of Europe, from Sicily to Sweden. Flax and hemp have as extensive a range as corn, but they are raised in the greatest perfection between the latitudes of 45° and 60°.

We have stated, that the superficial extent of Europe is about 3,432,000 square miles. If we draw a concave line from a point in the Uralian mountains, about the latitude of 60° or 61°, to the west coast of Norway, in the latitude of 69°, passing through the Lake Onega, and a little to the northward of the Gulf of Bothnia, this line will mark the extreme limits of cultivation, and will cut off a space equal to 550,000 square miles, or nearly one-sixth of Europe. The space cut off, however, is not entirely useless, as a part of it produces pasturage and wood. The cultivation of rye, oats, and barley, is confined to the region south of this line, and includes more than five-sixths of Europe; but in the northern parts of this zone, only a very small proportion of the land will bear corn. The region adapted to the cultivation of wheat comprehends about four-sevenths of Europe, and includes all the densely peopled parts. The region of the vine extends over three-sevenths of Europe.

Metals. Europe, in proportion to its extent, is probably richer in mineral wealth than the other quarters of the globe. It contains all the metals except platina; and though it affords gold and silver only in limited quantities, iron, copper, lead, with coal and salt, commodities of greater value to society, are abundant and widely distributed. The mountains, consisting of primitive and transition rocks, are the great depositaries of these mineral treasures.

Iron. Iron is found in all the chains of mountains in Europe. The richest mines are in the Dofrines, or Scandinavian Alps. But rich mines are also found in the Alps of Stiria, Carinthia, and Bavaria; in the Pyrenees, the Vosges, the Cevennes, the coal district of Britain, the Urals, the Carpathians, the Hartz, and many other places.

Copper. Copper is also widely distributed, though less abundant than iron. The richest mines are in Hungary, in the Carpathian mountains. It abounds also in the Saxon and Bohemian mountains, in the Dofrines, the Urals, the north of England, and the Alps; and it is found in the Vosges, the Pyrenees, and other mountains of Spain, in the north of Germany, and in Tuscany.

Lead. Lead exists in the Alps, Carpathians, Pyrenees, Cevennes, Vosges, the British mountains, and the Urals.

Tin. Tin is found only in a few places in Europe. The richest mines are in Cornwall; next to these are the mines in the Erzegebirge. It is also found in Hungary and Spanish Gallicia.

Mercury. Mercury, like tin, is confined to a few places. The mine of Idria, in Austria, which yields 8000 to 10,000 quintals *per annum*, is the most productive in Europe. There are also considerable mines at Deux Ponts, in the Palatinate; in the Spanish province of La Mancha, and in Transylvania.

Gold. Gold is widely diffused through Europe, but generally in such quantities as not to repay the expence of working. It is wrought, however, in the Carpathians, the Urals, the Dofrines, the Alps, and it is said, in Ireland. Anciently there were rich mines of gold in Spain and Greece.

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Silver. Silver is more abundant than gold, though less widely distributed. There are productive mines of this metal in the Erzegebirge, the Carpathians, the Urals, the Norwegian Dofrines, and in Sardinia. It is found also in the Alps, the Vosges, and the Sierra Morrena.

Coal. Of coal the richest mines are found in the north and west of England. It abounds also on both sides of the south of Scotland; in Ireland, in the Netherlands, in one-fourth part of the French territory; and occurs more sparingly in Saxony, Hanover, Denmark, Sweden, Russia, Hungary, Bohemia, Moravia, Silesia, Bavaria, Austria, Franconia, Westphalia, Swabia, Catalonia, and some other parts of Spain, in Portugal, and in Sardinia. After Britain, France is the country in Europe best supplied with this mineral. The produce of the French coal mines has increased fourfold within the last twenty-five years. (*Ann. Phil.* VII. 314.)

Salt. Salt is procured from the waters of the ocean, and, in the interior of Europe, from numerous salt mines and salt springs. The most productive salt mines in Europe are those in Poland, on the north side of the Carpathians; and those in Salzburg, on the north side of the Alps, both of which belong to Austria. There are also extensive depositaries of mineral salt in Transylvania and Hungary; in Valentia, Navarre, and Catalonia, in Spain; in Cheshire, in England; and in Bavaria and Switzerland. Salt springs are numerous along the sides of primitive mountains in most countries of Europe. The most extensive salt mines of Russia are in Asia.

Antimony, cobalt, zinc, manganese, sulphur, alum, and a great variety of other mineral productions, are found in Europe; but it is unnecessary to specify their localities.

It is observed, that the Alps, Pyrenees, Carpathians, and other mountain chains which run east and west, are richest in metals on the south side; while the Dofrines, Urals, and others which run north and south, are richest on the east side. Of the mountain chains of Europe, the Apennines are the poorest in metals, the Carpathians probably the richest. (Pinkerton's *Geog.* Mentelle et Malte-Brun, *Geog.*)

Different Races of Inhabitants. The present population of Europe is sprung from a variety of tribes, but authors differ much as to the number and peculiar characters of the original races. It would serve little purpose to enumerate the contradictory hypotheses which have been advanced on this subject. We shall, therefore, rather confine ourselves to an account of those more obvious general characters, founded on language, manners, or physical constitution, which distinguish the different portions of the population of Europe at present.

The nations in the south-west of Europe, the French, Italians, and Spaniards, speak languages in which the Latin idiom predominates. They have generally black hair and black eyes, are rather inferior in stature to the Gothic nations, but gifted with more imagination, and a higher degree of organic sensibility; they are more temperate, more inventive, but less persevering.

The Gothic race includes the English, Swedes,

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Norwegians, Danes, Dutch, and the various German nations inhabiting the country between the Rhine and the Oder, with the Swiss, Bavarians, and a part of the inhabitants of Bohemia, Moravia, and Austria. These nations are distinguished by fair hair, blue or grey eyes, large stature, and a clear complexion. They have less imagination than the southern nations, are more addicted to pursuits that exercise the understanding, are more thoughtful and serious, and less temperate in drinking.

The Sclavonic nations occupy the east of Europe generally, including Russia, Moldavia, Poland, ancient Prussia, with the greater part of Silesia, Hungary, Moravia, Bohemia, Croatia, and Sclavonia. They are rather lower in stature than the Gothic race, the countenance is shorter, but more animated, and the hair black. The prevailing religion is the Greek Christian, and in the western parts the Roman Catholic. They all speak dialects of the Sclavonic language, of which the Russian is one.

The remains of the Celtic tribes are found in the Highlands of Scotland, in Wales, Ireland, Britanny, and Biscay in Spain. They are rather low in stature, have lively eyes, prominent cheek-bones, red or yellow hair in the north, but sometimes black hair in the south.

The Finns in the north of Europe have a language of their own, and the characters of a peculiar race. They have light brown eyes, a pale complexion, cheeks hollow, are of middling stature, but heavy and muscular.

The Samoieds, Laplanders, and other tribes who live within the polar circle, are distinguished by their very low stature, the smallness of the legs and feet, and largeness of the head, prominent cheek-bones, small round black eyes, black and bristly hair, and a swarthy skin. The Laplanders, from intermixture with the Finns, Russians, and Norwegians, have lost, in some degree, the characteristic traits of the original race.

The modern Greeks and Albanians are supposed to be descended chiefly from the ancient inhabitants of the country, whose language they have preserved. They have a greater resemblance to the Latin nations than to those of the Gothic race. The Turks are an Asiatic tribe. *

Progress of Civilization.

Europe has been gradually advancing from poverty and barbarism to wealth and refinement since the tenth century, but the progress of the different nations has been very unequal. No single cause has contributed so much to their improvement as commerce; and hence the first advances have always been made by maritime states; and the progress of the different communities has been nearly in proportion to their vicinity to the sea, or the facility of their communication with it. The small republics of Italy and the Hanse towns were the seats of industry, wealth, knowledge, and freedom, while slavery, ignorance, and rapine, reigned in the countries around them. The tendency of commerce to enrich a country seems to depend on its power to create disposable capital. Though a certain species of opulence exists among the great landholders of agricultural countries, those masses of disposable capital which give vigour to industry, and supply the means of great improvements, are only found in commercial states. Commerce also favours the growth of manufactures, and these two species of industry raise up a middle class closely allied with the great body of the people. It is among this class that ideas of civil and religious liberty take their rise, and find their firmest supporters; whereas in countries entirely agricultural, liberty means only the domination of the aristocracy. The spirit of liberty once introduced, laws are improved, prejudices hostile to industry extinguished, and new vigour infused into every branch of society. It is thus that freedom and wealth have generally followed in the train of commerce; and that the commercial states have led the way in those improvements which have so much ameliorated the condition of Europe. When the Italian republics flourished, however, Europe was not in a state to be much benefited by the lights their experience afforded. The Dutch republic, which flourished at a later period, gave a more striking demonstration of the advantages of industry, freedom, toleration, and good government, at a time when neither liberty nor toleration were understood even in England, and when industry was in a very low state all over Europe. The example of the Dutch furnished statesmen with new ideas, and had a sensible influence on the policy of England, France, and other countries. The genius of Peter the Great derived from this small republic the seeds of those improvements by which civilization was spread over the vast empire of Russia. The superiority which the Dutch possessed has since been transferred to Britain, and she has acquired with it the privilege of instructing other nations in the sources of public wealth, and the science of government.

The Reformation had a material effect in accelerating the progress of society. It put an end to a multitude of abuses and prejudices adverse to improvement, and inspired the human mind with a new activity. Those countries in which it took no root seemed to have had their progress suddenly arrested, while others, less favoured by nature, derived new life and vigour from its influence. Italy and Spain, now so far behind Britain, France, and Germany, were the first countries in Europe for knowledge, wealth, and industry, at the period of the Reformation. The establishment of the Protestant religion produced a more liberal spirit among the Catholics in those countries where the two churches exist together; but in those countries where protestantism has never obtained a footing, the dread of its introduction has thrown the government more and more into the hands of the clergy; the clergy, armed with power, have become more jealous and intolerant, and have nearly put an end to all freedom of thought. The literary glory of Spain expired some time after the Reformation, and Italy has been checked in her career. The older writers of these countries breathe a spirit which would not

* Mentelle et Malte-Brun, I. 540.—M. de Stael, *Germany*, Introduction.

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be tolerated at the present day, nor does society there afford the elements out of which such characters could be formed. And thus it happened that the very same event which called forth the powers of the human mind in the north of Europe, extinguished the intellectual activity of the south.

The improved means of internal communication in countries in modern times, have had a considerable effect upon the state of society. In ancient times free states were necessarily small, because when neither the press nor the post existed, that union of sentiment, necessary to control the conduct of men in power, could not be effected among a large population scattered over a wide space. A number of free states sprung up in Greece, because that country, perforated by mountains and arms of the sea, afforded natural means of defence to such small societies as could then exercise the functions necessary to the preservation of freedom. It is a mistake to suppose that, in these states, a greater extent of territory could have been united under one government by adopting the representative system. The resolutions of a body of representatives would command no more respect from a government than those of as many private individuals, if they were not constantly supported by the opinions of the mass of society; and this requires such a rapid and general circulation of intelligence as could not then exist. The small size of the Grecian states was a necessary condition of their freedom; but it was a serious disadvantage, not only because it lessened the commercial intercourse between the different parts of the country, but because such small communities had not strength enough to resist a great force from without; and hence these states fell a prey to the superior power of the Macedonian monarchy. The whole of the south-west of Europe exhibits the physical features of Greece upon a larger scale. Its surface is broken into numerous sections by gulfs and mountains, and abounds in natural barriers. Favoured by these circumstances, the different communities in this quarter of the world in modern times, enjoyed a certain degree of independence and security, which hastened their progress in civilization. Russia, which occupies the only large plain in Europe, has been the last reclaimed from barbarism. So long, however, as the means of communication remained very imperfect in modern Europe, free governments were confined to small states, and the large were abandoned to feudal tyranny or military despotism; but the science of government has gradually improved, as knowledge, commerce, and the arts, have advanced; and, at present, the admirable inventions of the post and the press give such an electric rapidity to the circulation of public sentiment, that twenty millions of men could be as easily united in defence of their rights as the small population of Attica, in the time of Xerxes.

The progress of improvement tends to level all distinctions between states, but those founded on the extent of their natural resources. Capital, skill, intelligence, and all acquired advantages, tend to an equilibrium. When Europe was overrun with barbarism, the city of Venice, by its commercial wealth, was a counterpoise to two or three of the great monarchies of the Continent. The discovery of America, and of a passage by sea to the East Indies, gave a new direction to commerce, and undermined the greatness of that city. The Dutch republic rose by its freedom and industry, and was able, in the time of Charles II. to dispute the empire of the sea with the combined powers of England and France. But England increased her commerce, and improved her constitution, and having a larger and more fertile territory, as well as a greater population, she at length obtained an ascendancy over Holland, deprived her of the empire of the sea, and stript her of most of her colonies. At the beginning of the seventeenth century, Spain and Turkey were the first powers in the west and east of Europe, and inspired their neighbours with the dread of conquest. Sweden ruled with undisputed sway in the north; and Russia, now so formidable, was scarcely known. Spain, under a better government, might recover a part of her influence, but the Turkish empire seems near its dissolution; and the importance of Sweden and Holland is gone irretrievably, in consequence of the growing strength of the neighbouring powers. The extent of territory and immense natural resources of Russia must, in the end, raise her to a decided superiority over all the other powers of Europe, if the empire does not fall to pieces from its own weight, or get into disorder from the vices of its government. Its progress hitherto has been greatly aided by the personal characters of its sovereigns. If we were to judge merely from the advantages which different states possess for raising and supporting population, we might predict that, in the course of a century and a half, Russia would rule with uncontrolled sway over the old Continent, and the United States over the new; and that the other states, which now figure in the first rank in either hemisphere, would then owe their existence, like the small principalities of Europe at the present day, to the forbearance, or the mutual jealousy of their powerful neighbours. But, in the course of events, many changes may occur to give a different destiny to both Continents.

Number of Inhabitants.

The number of the inhabitants of Europe has been progressively increasing during last century, slowly in the earlier part of the century, but more rapidly as we approach the present times. Apparently it has been least considerable in Spain, Italy, Sweden, France, and Germany; rather greater in Prussia, Austria, and the British Isles; and greatest in Russia. Within the last thirty or forty years, the advance has been very perceptible, even in the countries which suffered by the war. When we compare the statements of the population of the different districts of Prussia, Austria, and Germany, as given in Hoeck's Tables, between 1790 and 1799, with those given by Hassel, in 1815, we find an increase almost everywhere. In 1787, Zimmermann estimated the population of Europe at 144,000,000; at present, according to the best authorities, it is about 184,000,000. This exhibits an increase of 40,000,000 in 32 years, which implies an annual augmentation of 7.7 in the 1000, or 1,416,000 persons on the present population; and at this rate, the number of inhabitants would double in about 90 years. There is no reason to think that this result differs materially from the true average during this period. In Britain, Russia, Si-

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lesia, and some other countries, the rate of increase has been still more rapid. The most obvious cause of this increase of population is the increase of production, from the improvement of agriculture and the arts; but part of the effect may be ascribed to the general introduction of potatoes in many countries, by which the same portion of ground is made to support three or four times as many persons as it would under corn. In France, where Mr Young, in 1789, found the cultivation of potatoes extremely limited, it is now so much extended, that, according to Chaptal, the annual produce is nearly 20,000,000 *hectolitres*, or 55,000,000 bushels,—a quantity fully as great in proportion to the population as Mr Colquhoun assigns to Britain and Ireland. This augmentation of numbers does not appear to have been accompanied with any deterioration in the habits of the people. On the contrary, the diminution in the rate of mortality which has taken place in Britain, France, and Sweden, is a decisive proof of an improvement in the condition of these countries; and by analogy, we may extend the same conclusion to the other parts of Europe. It may be remarked, that the general extension of commerce, and the accumulation of capital, render a season of scarcity, in a particular country, much less destructive now than formerly. In Britain, whose commerce and capital enable her to draw supplies from all parts of the world, the additional mortality, in the most severe scarcity, does not exceed one-tenth; but, in Sweden, a poor country, it sometimes amounts to one-third. (Milne's *Annuities*, p. 400.) In ancient times, when each country depended entirely on its own produce, the effects of a scarcity were dreadful.

Number of States, and their Comparative Importance.

The states of Europe at present are 57 in number and, considered with respect to political importance, may be divided into four classes. Britain, France, Russia, Austria, and Prussia, belong to the first; Spain, Sweden, Turkey, and the Netherlands, to the second; Portugal, Naples, Bavaria, Sardinia, Denmark, Saxony, Wirtemberg, Hanover, and Switzerland, to the third; Baden, Tuscany, and the States of the Church, with the other small states of Germany and Italy, belong to the fourth class. Objections may be made to this classification, but we have not been able to find a better; and a few remarks will explain the principle on which it is founded. The first five powers are the only powers that exercise a decided influence over their neighbours; and it is by their joint counsels that differences among the smaller powers are adjusted, and all questions that concern the general state of Europe decided. The four states of the second class visibly occupy a lower place in the scale of power than those of the first. They have very little exterior influence, but they are not directly controlled by any of the stronger powers; and it is only among them and the states of the first class that wars are now likely to originate. The third class includes those states which are too feeble, and too much under the influence of the great powers to become principals in war, but are of importance enough to be valued as auxiliaries by states of the first and second classes. The fourth class consists of states which have too little force to maintain any degree of independence, and owe their existence to the justice, the forbearance, or the mutual jealousies of the stronger powers. It is only in Europe that small states exist among large ones; and their existence is the consequence of that equality of power among the great states, which compels each to respect the rights of the others, and to pay a certain degree of deference to public opinion. The close union among four of the powers of the first rank since 1813, has established their influence over the rest of Europe much more firmly than at any former period.

Statistical Sketch of the more considerable Powers.

A *detailed* account of the principal European States is given under the proper heads in the ENCYCLOPÆDIA, or in this SUPPLEMENT. Our object here is only to bring together such *general facts* as will afford a comparative view of the internal condition, power, and resources of those larger societies which comprise the greatest part of the population of Europe. With respect to the smaller states, we cannot make room for any further details than what are contained in the TABLE, which forms the conclusion of this article.

BRITAIN.

Though much smaller in extent than any of the other states of the first rank, Britain is the most wealthy and powerful of the whole. She has a moderately good climate, a soil less fertile in grain than that of France, but affording better pasturage; an extensive line of sea-coast with numerous harbours; a natural and well defined frontier, a good commercial position, and the largest fields of coal in Europe. But all these advantages have contributed less to her aggrandisement than the excellence of her laws and constitution. The progress of Britain in commerce, manufactures, and agriculture, within the last century, and especially within the last 40 years, has been wonderfully great.

The British Isles contain about 76,000,000 of acres, of which about 49,000,000 are in cultivation, and 27,000,000, or more than one-third, waste or uncultivated. About one-half of the waste land is in Scotland, where the cultivated soil forms only 26 parts in the 100 of the whole surface of the country; in England it forms 82 parts in the 100, and in Ireland 69.* The agriculture of Britain, compared with that of the Continent, is distinguished by the farms being generally larger, the plan of cultivation more systematic and skilful, the produce on equal soils greater, the pasture land bearing a higher proportion to the land in tillage, and the breed of animals being superior. In Scotland the pasture land forms about one-half of the land in cultivation; in England four-sevenths. The whole annual produce of grain in Britain and Ireland

* Colquhoun's *Treatise on the Wealth, Power, and Resources of the British Empire*, 1815, p. 56, 57. Sir J. Sinclair, *Pamphleteer*, X. 94.

Europe. is estimated by Dr Colquhoun at 35,000,000 of quarters, excluding seed; of which, wheat is supposed to form 26 parts in the 100 in quantity; barley 17 parts, oats 49, rye 2, pease and beans 5. The value of the annual produce of grain is computed by the same author at L. 73,700,000; that of the pasture land at L. 89,200,000; and the whole gross produce of all the branches of agriculture, including gardens and cattle, at 216,000,000. But as this estimate was made in 1812, when prices were uncommonly high, a third or a fourth should be deducted for the present value. The valued rack-rent of England and Wales, as returned to Parliament by the Commissioners of Taxes in 1810, was L. 29,503,073, which gives 15s. 6d. as the average of rent of all kinds of land *per* acre. The rental of Scotland in 1813, according to Sir John Sinclair, was L. 5,041,779, including mines and fisheries; and deducting L. 341,000 for these, the rent of land will be L. 4,700,000, or 4s. 11d. *per* acre on an average. (*Pamphleteer*, X. p. 94.)

The progress of Britain in manufactures has been still more rapid, within a recent period, than in agriculture; and her natural advantages for this species of industry are perhaps more exclusive. She has a good supply, within herself, of the raw material for all her staple manufactures except cotton; and her means of procuring this article are, at least, equal to those of her neighbours. The growth of this manufacture in Britain has been unprecedentedly rapid. In 1767, the value of all the cotton goods manufactured did not exceed L.200,000; and, in 1812, it was estimated at L.29,000,000. The produce of the woollen manufactures, in the same year, including the raw material, was estimated at L.26,000,000; that of leather at L.15,000,000; of linen at L.15,000,000; and the whole produce of manufacturing industry, *exclusive* of the value of the raw material, at L.114,000,000. (Colquhoun, p. 91.)

The commerce of Britain seems to have increased pretty regularly during the first sixty years of the last century; but, from 1760 to 1786, it remained almost stationary. From this period to the present time, the increase has been rapid beyond example. The exports of England, about 1700, were L.6,045,000; in 1760, L.14,694,000; in 1786, L.15,385,000. (Chalmers, *Hist. View*, p. 315.) In 1818, the official value of the exports of the United Kingdom was L.53,559,711; of the imports, L.36,900,681, exclusive of the trade between Britain and Ireland. The mercantile tonnage in 1818 was 2,674,468, including that of the colonies, and the number of seamen 173,609. (*Parliamentary Papers.*) The annual produce of foreign commerce, or the sums derived from it by all classes concerned in it, were estimated, in 1812, at L.46,373,478; the gains from inland trade at L.31,500,000; and the whole annual produce of industry, from all sources, at L.430,000,000. (Colquhoun, p. 96–100.)

The growing wealth of Britain has had to sustain an increasing weight of public burdens. The public revenue of England, at the Union in 1709, was L.5,691,803; of Scotland, L.160,000. In 1763 (a year of peace) the nett revenue was L.9,100,000; in 1790, L.15,986,068; and, in 1812, it was L.64,979,960, of which England furnished L.55,995,123, Scotland L.4,155,599, and Ireland L.4,882,264. (Colquhoun, p. 262.) In the year ending 5th January 1819, the nett revenue was L.55,741,098, which was collected at an expence of L.8, 3s. $4\frac{3}{4}$d. *per cent.* The nominal amount of the national funded debt, at 5th January 1819, was L.802,296,265, including about L.7,000,000 of loans to Austria and Portugal; the unfunded debt was L.51,992,095. The interest on the funded debt was L.27,999,389; adding to this L.2,500,000 for interest on unfunded debt, we have L.30,500,000; and, assuming the true rate of interest to be 5 *per cent.*, the capital of the national debt may be valued a L. 610,000,000. The army, on the 25th January 1819, was 104,369 men. The navy consisted of 173 ships of the line, and 448 of inferior size, including ships building, with 20,000 seamen. (*Parliamentary Papers; Navy List.*) Europe.

The population of England appears to have doubled in the 100 years ending 1811; that of Scotland appears to have increased one-half in the same period; that of Ireland is supposed to have doubled within the short space of 46 years. (Colquhoun, p. 10.) In the period between 1801 and 1811, the rate of increase, in England and Scotland, was such as would have doubled the population in 52 years. (Milne, *Ann.* p. 112.) This rapid increase of numbers appears not to have been accompanied with any deterioration of condition, at least in the people of England and Scotland. In the five years ending 1784, the annual mortality in England and Wales was 1 in 37; in the five years ending 1810, it was 1 in 47.86. The average number of poor relieved in these 10 years was 1 in 8, 9, or nearly one-ninth of the inhabitants. (Milne, p. 437–442.) Of the population of Britain and Ireland, about 35 families in the 100 are employed in agriculture, 45 in trades, manufactures, and handicrafts, and 20 in other occupations. The total population of Britain and Ireland, in 1819, according to the rate of increase indicated by the returns for 1801 and 1811, should be about 18,740,000. To these must be added about 875,000 British subjects in the various colonies, and about 45,000,000 of native inhabitants and negroes, making a total of 64,615,000 persons. (Colquhoun, p. 7.)

France.

This country enjoys, upon the whole, greater natural advantages than any other in Europe. Her territory is above one-half larger than Great Britain and Ireland, and is superior in soil and climate. She has a greater proportion of arable land than any of her neighbours; the natural means of communication between her provinces are abundant and easy; she is well provided with all the useful metals except tin, and is better supplied with coal than any other country in Europe except Britain. When we add to these advantages the intelligence and activity of her population, and consider that corvees, tithes, feudal services, and most of those abuses which shackled her industry, are now removed; that she is likely to enjoy the benefits of good laws and

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a free constitution, and is not encumbered with a great national debt, we cannot doubt that, if peace continue for any considerable length of time, she will yet rise to a much higher degree of wealth and prosperity than she ever before possessed. Even during the distractions of the Revolution, though her commerce was annihilated, her agriculture and manufactures have been extended and improved, her population has increased, and their condition has been ameliorated. The greatest bar to her progress will probably be the extreme division of property; and, for some time, the want of capital.

The surface of France contains within its present limits 52,000,000 hectares, or 128,000,000 acres. From partial surveys, for fiscal purposes, made in each department, it is estimated that the waste land, including roads and rivers, amounts to one-eighth of this, or 12 parts in the 100; the arable land to 44 parts in the 100; the woodland to 14 parts, the pasturage land and meadows to 14, the vineyards to 4, wild land 7, quarries, buildings, orchards, gardens, olive and other plantations, make up the remaining 5 parts. (Chaptal, *de l'Industrie Francoise*, I. 205. Paris, 1819.) In addition to the vegetable productions that grow in England, the climate of France enables her to raise maize, vines, olives, mulberries, and chesnuts; and by some of these a produce is extracted from soil which, in England, would yield nothing. The whole produce of grain in France is estimated, by Chaptal, at 143,000,000 hectolitres, equal to 50,000,000 quarters, or 40,000,000, deducting one-fifth for seed, which is only 5,000,000 above the produce of Britain and Ireland, as estimated by Colquhoun. Of this produce of grain, wheat forms 36 parts in the 100, rye 21 parts, maize 4½, buckwheat 6, barley 9, oats 22, legumes 1. The quantity of potatoes (19,800,741 hectolitres) is equal to two-thirds of the rye. The produce of 4,000,000 of acres planted with vines, in 1808, was 37,600,000 hectolitres of wine. (I. 173, 177.) The *annual gross produce* of the land, which was estimated, by Arthur Young, at L.230,000,000 Sterling, is estimated, by Chaptal, at 4,678,000,000 of francs, or L.187,000,000 Sterling,* of which the principal items are,

Corn and legumes (secs), -	L.77,172,000
Vines, - - -	28,757,000
Forage, - - -	27,322,000
Wool, - - -	3,253,000
Raw silk, - -	617,000
Hemp, - - -	1,237,000
Flax, - - -	760,000
Woods and forests, - -	5,657,000
Cattle, sheep, and swine, -	17,880,000
Poultry, - - -	2,588,000
Fruits, - - -	2,584,000
Pulse and other esculent vegetables (legumes frais), -	7,872,000

(Chaptal, I. 226–238, Young, I. 468.)

Revenue imposable.

The mean revenue derived from a hectare of land is estimated at 28 francs, or 22s. 6d. equal to about 9s. 1d. *per* acre; and the revenue of the whole departments, calculated on this basis, is L.59,449,000; but, calculated according to the reports of special Commissioners, in 1815, it is L.65,040,000. The last sum includes houses, and may be considered as corresponding nearly to the rackrent of lands and buildings in France. (I. 208–212.) This is certainly too low. The average rent of all kinds of land in France was estimated, by Young, at 15s. 10d. *per* acre. (*Trav.* I. 476.) The most peculiar feature in French agriculture is the vast number of small proprietors, who cultivate their patches of land by their own labour. Arthur Young supposed that, before the Revolution, one-third of the property of the kingdom was held by such persons; and Chaptal says the number of proprietors is doubled within the last thirty years. The latter computes the whole number of farms in France at 3,000,000; so that, on an average, each cannot exceed 43 acres, including wastes. In the cultivation of good soils, the agriculture of France is nearly equal to that of England, but it is much inferior in the management of poor soils, in the system of cropping, and in the breed of animals. It has been much improved, however, during the Revolution, by the extensive cultivation of artificial grasses, by augmenting the live stock, by the general exclusion of fallows, and by increasing the cultivation of potatoes. †

The manufactures of France, amidst all the troubles of the Revolution, have been generally advancing, though some branches have retrograded. The number of workmen employed in Lyons, the principal seat of the silk manufacture, was one-fourth greater in 1812 than in 1789. France produces within herself about eleven millions of pounds of raw silk, and imports nearly as much; and the total value of the manufactured articles produced is estimated at L.4,300,000. Of wool, France produces about eighty-three millions of pounds (Avoirdupois), valued at L.3,253,000, and imports twenty-six millions of pounds; which, converted into various fabrics, is estimated to be worth L.8,000,000 Sterling. The value of the manufactures of flax and hemp is estimated at L.11,712,000. The spinning of cotton by machinery, which was scarcely introduced before the Revolution, employed one million of spindles in 1812; and there were 220 establishments for spinning cotton in 1818. The cotton imported in 1817 amounted to thirteen millions of kilogrammes, or twenty-eight millions of pounds, which, when worked into fabrics, is estimated to be worth L.7,664,000. This is only about one-fourth of the value of the cotton manufactures in Britain; but in France this species of industry has had to struggle with extraordinary difficulties. The manufactures of iron in France are estimated at L.8,292,000; those of leather at L.5,732,000. The whole gross produce of manufacturing industry, including manufac-

* Reckoning the Pound Sterling equal to 25 francs, its real value at present is 25.2. See the article EXCHANGE.

† Chaptal, I. 139, 144, 153, 224, &c. Birkbeck's *Tour in France*, 1814, p. 109.

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turers' profits, is estimated at 1820,000,000 of francs, or L. 72,800,000, of which the value of the raw material forms 32 parts in the 100, wages 47, manufacturers' profits 10, and expences 11. (Chaptal, II. 116-120, 145, 203.)

With regard to the commerce of France, we have no satisfactory details to present for any recent period. According to Arthur Young, the commerce of France nearly quadrupled, between 1718 and 1786. (I. 520.) In the three years ending in 1789, the imports on an average were 613,543,000, and the exports 448,748,000 francs, or about 24½, and L.17,000,000 Sterling. (Chaptal, I. 134.) In the public journals (Magazines and Newspapers) we find the exports of France for 1818 stated at L. 15,400,000.

The population of France, notwithstanding the interruption to industry, and the drains occasioned by the long wars, has increased since the commencement of the Revolution. According to calculations made by the National Assembly in 1791, France contained 26,363,074 inhabitants, and, in 1818, it contained 29,327,388 within the same limits. (Young's *Travels*, I. 479. Chaptal, I. 206.) This shows an augmentation of 4 in the 1000 annually; but in a period of peace, the rate of increase must be much greater. The condition of the labouring classes also appears to be improved. Wages, which Arthur Young estimated at 19 sous or 10d. English *per* day, throughout the kingdom for all kinds of work, were estimated at 1s. 5½d. *per* day, in 1814, by Mr Birkbeck, who considers this sum as equivalent to 2s. 11d. in England. The annual mortality, which was estimated at 1 in 30 by Neckar before the Revolution, we find stated recently to be 1 in 35. (Malte-Brun, *Precis Geog.* II. 563.)

According to returns made in 1815, there were then in France 22,300 primary schools, with 737,379 pupils. There were besides 368 secondary schools, 36 lycees, and 26 universities.

The public revenue of France was estimated, in the ways and means for 1819, at 889,209,500 francs, or L. 35,568,000. The public debt is stated at L. 127,000,000, and the interest at L. 9,666,000. The army 140,000. The navy, 40 ships of the line and 30 frigates. The secular clergy, according to Crome (p. 214), amount to 51,300, with 700 francs each of salary, besides 50 bishops, and 9 archbishops, with 15,000 and 25,000 francs a-year. We cannot believe the number to be so great. The revenues of the church, calculated on this basis, would amount to L. 1,475,000. Before the Revolution they amounted to L.5,687,500, and lately we find them stated at 20,700,000 francs, or L. 828,000 for 1817. (*Public Journals;* Young's *Travels;* Hassel.)

Acquisitions of France in Territory and Population from the commencement of the Revolution to the Peace in 1815.

		Square Miles.	Population.
From 1792 to 1801 (Peace of Luneville)	Austrian and Dutch Netherlands,	10,100	2,150,000
	Carried forward, -	10,100	2,150,000
	Bishopric of Liege, part of Archbishoprics of Cologne, Treves, Mentz, Duchy of Juliers, Palatinate, Moeurs, and Gueldres, - -	12,600	2,050,000
	Department Montblanc (4-5ths), Leman, Maritime Alps (1792), with Venaissain (1790), Montbeliard, and other *enclaves*,	4,710	825,000
		27,410	5,025,000
1801 to 1812.	Piedmont (1802), Genoa, Tuscany (1806), Parma (1808), Roman States (1810), and the Valais,	26,600	5,130,000
	Holland, Bremen, Hamburgh, Lubec, part of Hanover, Oldenburg, Munster, and Osnaburg (1810), - -	36,500	4,530,000
	Illyrian Provinces on the north shores of the Adriatic, including Venetian Dalmatia,	19,300	1,372,000
		109,810	16,057,000
	Add Territory and Population of old France in 1812, -	204,000	28,500,000
		313,810	44,557,000
	States Dependent on France.		
	The Cisalpine Republic, afterwards the kingdom of Italy, established in 1797, consisting of Austrian Lombardy, with a district of Sardinia, the Bergamesco, Bresciano, Modena, Massa, Carara, Bologna, and Romagna, to which were added, in 1805, the Venetian Territories in Italy, and, in 1808, the remainder of the Roman States east of the Apennines, -	31,000	6,350,000
	The Confederation of the Rhine, formed in 1806, was augmented from time to time, and ultimately included nearly all the small states comprehended in the present German confederation. There were 22 members in 1812, exclusive of France, - -	113,000	14,000,000
	Naples, - -	30,500	4,963,500
		489,310	69,870,500 *

By the peace of Paris in 1815, France was stript of all her conquests, and reduced within her ancient limits, as they stood in 1789, with some inconsider-

* Hoeck, *Apercu Statist.;* Hassel, *Allg. Europ. Staats;* Malte-Brun et Mentelle, *Geographie et Atlas.*

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able variations, not sensibly affecting her whole extent of territory, or amount of population.

Austria.

The Austrian empire is one-fourth larger than France, and twice as large as Britain and Ireland. Its population consists of a mixed mass of nations, differing in origin, language, religion, and manners, having few common ties, and little intercourse with one another. Austria has but a small extent of sea-coast, and is almost entirely an inland power. The climate is similar to that of France, but subject to greater extremes of heat and cold, the soil not much inferior, the grain and fruits nearly the same. She is richer in mineral wealth than any other state in Europe, and possesses coal though not in great abundance. Her natural resources are capable of vast improvement, and in the hands of a wise and liberal government, would soon raise her far above the rank she now enjoys. Of the six sections into which her territories are divided, Lombardy is the most populous in proportion to its extent; Bohemia and Moravia are next in population, and are the seats of the chief manufacturers; Austria Proper and Hungary are remarkably rich in mines; and Galicia, though in a low state of cultivation, is fertile in grain, and contains the most productive mines of salt in Europe. Austria has but a slender title to be regarded as a German power; less than one-fifth of her population are Germans. The Sclavonic race, who form nearly one-half of the population, give a character of ignorance and backwardness to the government. In Bohemia, Hungary, and other provinces where this race predominates, vassalage exists in some of its forms, and cramps the progress of society. The Austrian empire, in truth, consists properly of six separate governments, feebly united under one head. Each of these governments, except that of Lombardy, has a diet or states, composed of the deputies from the nobility, clergy, and towns; but these bodies exercise no real influence over the government, except in Hungary, where the old feudal institutions remain in vigour, and the aristocracy have always maintained a great degree of independence.

The surface of the Austrian monarchy is estimated at 258,000 square English miles. Of this surface, the waste lands, including morasses, mountains, rivers, and ground covered with buildings, is estimated at 5 parts in 24, the useful soil at 19 parts in 24; and of the useful soil, about 43 parts in the 100 are in tillage, 9 parts meadow land, 9 parts commons, which support cattle, 2 parts vineyards, 2 parts gardens and orchards, and 35 parts forest land. The total produce of grain is estimated at 165,500,000 metzen, or about 35,670,000 quarters; consisting of, wheat 14 parts, barley 11, rye 31, and oats 44. In 1804, the net produce of a joch (equal to 1½ acre) of corn land, for the whole Austrian states, was valued, by Lichtenstern, at 5 florins (10s.), and of pasture land at 2 florins (4s.). (Hassel's *Stat. abris des Oest.* p. 90.) The annual produce of wine in the Austrian dominions is estimated at 36,000,000 to 40,000,000 of eimers (each equal to 14 English gallons), of which Hungary furnishes nearly two-thirds. This is rather more than one-half of the produce of the French vineyards. Galicia is the only province in which there are no vines. Hungary and Sclavonia supply 180,000 centners of excellent tobacco. The Ex-Venetian states furnish yearly 1,200,000 pounds of silk; Milan and the Tyrol nearly as much; and altogether this species of culture employs 400,000 persons. Flax, hemp, hops, and fruits, are also extensively cultivated; and the forests, which cover more than one-fourth of the empire, furnish an ample supply of wood. The total produce of the vegetable kingdom is valued at L. 68,500,000 Sterling,—a small amount, considering the extent of the country; but agriculture, though there are numerous societies for its improvement, remains in a low state, from the prejudices of the higher classes, and the oppressions to which the peasantry are exposed. The horses in the empire are estimated at 1,800,000, the sheep at 12,000,000, and the horned cattle at 10,000,000: The live stock has greatly diminished within the last twenty-five years. The annual produce of the mines is 3846 marks of gold (the mark is about three-fourths of a pound Troy); 486 centners (hundred weights) of silver; 56,000 centners of copper; 30,000 centners of lead; 4890 centners of tin; 1,200,000 centners of iron; and 5300 centners of mercury. About 5,500,000 centners of salt are prepared, the greatest part from salt mines and springs. The annual produce of these minerals in 1802, when it was probably one-third less than the above, was valued at L.4,700,000.*

The leading manufactures are linen, cotton, woollen, silk, leather, and works in metal and wood. The linen manufacture existing in all the provinces, but to the greatest extent in Bohemia and Moravia, is supposed to employ 1,200,000 persons; the woollen manufacture 300,000 persons; the cotton 100,000; about 18,000 or 20,000 centners of cotton were spun by machinery in 1817, which is three times the quantity spun in 1803. The silk manufacture, which is carried on chiefly in Lombardy, employs 110,000 persons. The most considerable manufactures in metal are in Styria, Carinthia, and Lower Austria. The estimate of the annual products of the Austrian manufactures, given by Crome, is too extravagant to deserve any credit. But those of Bohemia, in 1811, were valued at 158,000,000 of florins, and if we add twice as much for all the other states, the whole produce of the Austrian manufactures may, on this ground, be computed at L. 47,000,000 Sterling. Even this is probably above the truth. (Lichtenstern, p. 44. Crome, 173-176.)

The commerce of Austria is extremely trifling. She possesses but a small extent of sea-coast, which is remote from the centre of her territories, is destitute of navigable rivers, and rendered difficult of ac-

* Lichtenstern, *Handbuch, der Neust Geog. des Oest.* 1818, p. 33—42. Crome, *Allg. Ubersicht,* 1818, p. 141-154; Mentelle et Malte-Brun, IV. 419.

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cess by mountains. The numerous rivers that water her dominions afford few advantages to her trade, as (excepting in Italy) she does not command the outlet of any one of them. The whole exports of this large empire are only L. 3,000,000, and the imports L. 3,200,000. (Lichtenstern, p. 48.)

The population of the Austrian empire, in 1817, was 28,207,886, of which the Sclavonic race amounted to 13,182,000, the Germans to 5,342,000, the Italians to 4,226,000. the Magyars, or Hungarians, to 4,225,000, the Wallachians to 1,246,000, and the Jews to 487,000. (Lichtenstern, p. 1858.) There are besides considerable numbers of Greeks, Turks, Albanians, and Armenians, so that, except Russia, no state in Europe has such a heterogeneous population. Throughout the Austrian dominions, the nobility and clergy are numerous, and many of them very rich. In Hungary, Galicia, and indeed in the greater part of the empire, these classes are exempt from taxes, and enjoy other pernicious privileges. The Austrian clergy, exclusive of their families, are estimated at 64,000, of whom 56,000 belong to the Catholic church ; the nobles of both sexes at 475,000, the civil servants of the government, with their families, at 280,000 ; the military, men, women, children, and servants, at 800,000 ; the burghers and tradesmen, with their families, at 2,333,000 ; the persons engaged in agriculture at 4,005,000 families, or about 20,025,000 individuals. (Lichtenstern, p. 133.) In all the provinces, especially in Bohemia, Moravia, and Hungary, there has been a rapid increase in the numbers of the inhabitants. Though the people are poor and ignorant, the government has been at much pains to provide them with the means of instruction ; and the numerous schools and academies established, must essentially contribute to the improvement of the country. The Catholic religion, though it predominates, nowhere enjoys that exclusive ascendancy which produces such pernicious consequences in Spain and Italy. The other sects, Greeks, Calvinists, Lutherans, form nearly one-third of the inhabitants in the provinces beyond the Alps ; and this circumstance, by generating a certain freedom of thought and discussion, must prove favourable to the progress of society.

Acquisitions and Losses of Austria from the Commencement of the French Revolution to the Year 1815.

Austria, in 1787, 240,000 square miles, 20,000,000 inhabitants. (Zimmermann's *State of Europe*, p. 150.)

	Square Miles.	Inhabitants.
Gained 1795, In Poland,	17,500	1,100,000
1797, The Venetian territories east of the Adige,	13,450	2,023,000
1802-4, Trent, Brixen, Lindau, and other small territories,	4,800	290,000
	35,750	3,413,000
Lost ——, The Netherlands,	10,100	2,150,000
The Milanese,	4,100	1,320,000
The Brisgau,	1,150	140,000
	15,350	3,610,000
Absolute gain of territory, and loss of population,	20,400	197,000
Peace of Presburg, 1805.		
Lost Venetian territories,	13,450	2,023,000
The Tirol, Burgau, Eichtadt, Passau, Lindau, Rottenfels, and other small territories ceded to Bavaria, and seven towns to Wirtemberg,	11,000	815,000
	24,450	2,838,000
Gained Salzburg and Bertholsgaden,	3,610	202,000
Absolute loss,	20,840	2,636,000
Peace of Vienna, 1809.		
Lost Salzburg and Bertholsgaden,	3,610	202,000
Part of Inviertiel and Hausruck in Upper Austria, ceded to Bavaria,	1,900	224,000
Carniola, two-thirds of Carinthia, Goritia, Dalmatia, and part of Croatia, ceded to France,	14,600	1,065,000
In Poland, Wester Galicia, the circle of Zamosc, and the district of Tarnopol,	25,000	1,904,000
	45,100	3,395,000
Austria, in 1809, 205,000 sqr. miles, and 20,435,000 inhabitants. (Marcel. de Serres, *Voyage* I. 40.)		
Gained 1814-15, Salzburg, Tirol, Carniola, and other districts in Austria, formerly ceded, with Dalmatia, Croatia, &c.	30,100	2,140,000
Poland, district of Tarnopol,	3,900	400,000
Venetian territories and Milan,	17,000	3,959,000
	* 51,000	6,499,000

Austria, in 1818, 258,000 square miles, and 28,207,882 inhabitants. (Lichtenstern, p. 8. 1858.)

Prussia.

Prussia is the smallest in extent, and enjoys the fewest natural advantages of all the European states of the first class. Her territory is not much more than two-fifths of that of Austria; it is but indifferently fertile ; has few valuable mines ; few

* Hoeck, *Apercu ;* Marcel. de Serres, *Voyage en Autriche* 1814 ; Hassel, *Allg. Europ. Staat ;* Mentelle et Malte-Brun, *Geog. et Atlas.*

resources for manufactures: she has, however, pretty large extent of sea-coast, and a considerable commerce. Her possessions are straggling and disjointed; they present an extensive frontier, with little depth, and no natural barriers; and are inhabited by people who speak different languages, and have few common ties or interests. Prussia has sustained her rank chiefly in consequence of the superiority of her internal organization. Her government, unlike those of the other monarchies of Europe, being of very recent origin, is not encumbered by those ancient establishments which the change of circumstances has converted into abuses. The frame of her public institutions was improved and completed by the Great Frederick, who availed himself of all the lights and philosophy which the age furnished. He established a complete toleration in matters of religion; curtailed the oppressive privileges of the nobles; simplified the administration of justice; and introduced order and economy into every department of the government. He left the kingdom to his successor with a large and well disciplined army, and a high reputation for policy and prowess. The population of Prussia, of whom two-thirds are Protestants, is more intelligent than that of Austria, includes a greater proportion of Germans; and altogether she is more of a German power. The large rivers that water her territories have generally a very level course, and being joined by canals, they afford a great extent of inland navigation. Of all the old provinces Silesia is the most industrious and flourishing. It doubled its population in the 73 years between 1742 and 1815.* The Westphalian and Rhenish provinces are the most populous; ancient Prussia and the Polish provinces the least. In many parts of Prussia vassalage existed lately, and perhaps still exists. It was only subsequent to the disasters of 1807, that the nobles, who amounted, in 1802, to 20,000 families, lost their monopoly of military offices of rank, and the right of holding property exempted from public burdens; and since that period also the restrictions on industry in towns have been done away by the abolition of corporation privileges. (Crome, 417; *MS. Travels in Germany.*)

Agriculture remains in a low state in Prussia, in consequence of the ignorance and depressed state of the peasantry, the small size of the farms, the deficiency of capital, and the want of markets for the surplus produce. Besides the common species of grain, tobacco, mulberries, vines, flax, and hemp, are cultivated. Great quantities of potatoes are also raised. Horned cattle and sheep are pretty numerous in most of the provinces. M. Krug estimates the mean rent of an arpent of corn land, for the whole Prussian states, at $2\frac{1}{12}$ rix-dollars (about 7s.), and the *net produce* of an arpent of corn land at two-fifths of the gross produce; but of pasture land at one-fourth or one-fifth only, including poultry and bees.† According to returns made from the different provinces to the government, the whole annual produce of grain in Prussia about 1802, when the population was 8,754,000, was 4,500,000 *Wispel* (equal to 9,600,000 quarters); of which wheat formed 9 parts in the 100, rye 40, barley 24, and oats 27; of this quantity one-tenth was exported. The Prussian silver mines yield annually about 20,000 mark of silver; the county of Manifield alone furnishes 14,588 centners of copper; and Silesia affords 7600 centners of lead, and 405,900 centners of iron. The whole mineral produce of Prussia is valued at L.1,800,000 annually. (Mentelle et Malte-Brun, IV. 428; Crome, 400.)

The principal manufactures of Prussia are linen, woollen, cotton, silk, leather, iron, and porcelain, all of which are making progress. The linen, of which the chief seat is in Silesia, is the most considerable, and, as far back as 1804, was computed to produce yearly L. 2,5000,000 Sterling. The produce of the woollen manufactures, in 1805, was estimated at L. 900,000; that of leather at L. 600,000. The whole produce of manufactures, including breweries, we find stated, in 1802, at 41,000,000 of rix-dollars, or nearly L. 7,000,000 Sterling. Considering the extension of the kingdom, and the progress of domestic improvement, it must now be at least double. Of the commerce of Prussia we have no precise account for any recent period; but, in 1804, the imports of Silesia alone amounted to L. 1,900,000, and the exports to L. 2,100,000, exclusive of a transient trade valued at L. 700,000; and, in the same year, the imports of six provinces amounted to L.4,585,000. Supposing the trade of the other five provinces, of which the kingdom now consists, to be in proportion, and allowing for the advancing state of the country, we cannot estimate the whole imports at less than L. 8,000,000 or L. 9,000,000 Sterling, and the exports at as much. In 1802 the exports were stated at L. 7,000,000 Sterling, by Malte-Brun.‡

The public revenue of Prussia in 1817, according to Demian, was 42,000,000 dollars, or about L. 7,000,000. § After the great loss of territory in 1807, it was only L. 2,700,000. The public debt in 1815, including that of the new provinces, was estimated at L. 40,000,000. The army is about 175,000 men, exclusive of the landwehr. ||

In proportion as the other great states of Europe improve their natural resources, the importance of Prussia must decline. The time is past when the good order of her finances, and the discipline of her armies, could raise her to an equality with France and Austria and Russia; and she can only now support her rank by cultivating still farther those moral advantages which were formerly the source of her strength. It is the king's interest to give his subjects a free constitution and a free press, for which they are better prepared than those of any other great power on the Continent, except France. This would give a new impulse to industry, and create a

* Mentelle et Malte-Brun, *Geog.* IV. 265. Hassel, *Allg. Europ. Staats,* I. 71.

† Storch, *Cours d'Economie Politique,* 1815. II. 241, 273.

‡ Mentelle et Malte-Brun, II. 30. IV. 429. Crome, 423–443.

§ Handbuch, *der neuest. Geog. des Preuss. Staats,* 1818. p. 168.

|| Hassel, *Allg. Europ. Staats,* I. p. 68-75. Crome, 448.

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spirit of improvement, which would more than counterbalance the natural disadvantages of the soil and climate. Were the king to enter cordially into the new opinions which are rapidly spreading over Germany, and to put himself at the head of those who support them, in the present temper of men's minds, it is probable he might unite a great part of northern Germany under his sway.

Acquisitions and Losses of Prussia since the commencement of the French Revolution.

	Square Miles.	Inhabitants.
1791, Gained Principalities of Anspach and Bayreuth,	3,500	420,000
1793, do. in Poland, 2d Partition, . .	22,500	1,136,000
1795, do. do. 3d do.	16,500	860,000
1802, Received part of the German indemnities, and gave up possessions on the left bank of the Rhine, balance in favour of Prussia, . .	3,600	420,000
	46,100	2,836,000
Prussia in 1803, 116,000 sqr. miles, and 9,100,000. (Mentelle Malte-Brun, IV. 202 and 428.)		
1806, Prussia took possession of Hanover, but was dispossessed by the French a few months after.		
1806-7, Lost all her possessions between the Elbe and the Rhine, with Anspach and Bayreuth, Cottbus in Saxony, Neufchatel, and four-fifths of her Polish territories,	56,500	4,450,000
Prussia in 1808, 59,600 square miles, and 4,559,550 inhabitants. (Hassel, *Europ. Staats*, I. 68.)		
1814-15, Recovered a part of her losses in Poland, and all her possessions in Saxony and Westphalia, with great additions, and made some exchanges. Total gain of territory and population, .	44,600	5,506,000
Absolute gains of Prussia in each province.		
In Poland, in 1793 and 1795,	39,000	1,996,000
Add gained in 1772 at 1st partition, . .	12,000	600,000
	51,000	2,596,000
Lost in 1807, and not recovered in 1814, ...	27,000	1,575,000
Still retains, . .	24,000	1,703,000

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	Square Miles.	Inhabitants.
Brought forward,	24,000	1,703,000
(The population of the Polish provinces appears to have increased one-fourth since their first conquest.)		
In Saxony. Gained in the Duchy of Saxony, in Lusatia, Merseburg, Eichfield (part), Erfurt, and some towns, . .	7,800	920,000
In Westphalia and on the Rhine. Munster (three-fifths), Paderborn, Mark, Berg, Juliers, Electorate of Treves (four-fifths), Cologne, Duchy of Westphalia. Ceded East Frisia, Lingen, Hildsheim, . . .	14,200	2,050,000
In Pomerania. Swedish Pomerania, ...	1,480	120,000
	47,480	4,793,000

Prussia, in 1815, 105,800 square miles, and 10,315,000 inhabitants. (Demian, *Geog. Preuss.*) In 1817, 10,588,157 inhabitants. (*Public Journals.*)

Russia.

Russia occupies very nearly one-half of the surface of Europe, and yet her territories in this division of the globe are scarcely more than one-fifth of her whole dominions. Three-fourths of her Asiatic territories, however, consist of sandy deserts, or frozen plains, which yield very little for human subsistence; and her possessions in Europe are at present, and perhaps will always be, the most valuable part of the empire. European Russia consists chiefly of an elevated plain, over which numerous rivers flow with a small declivity, so as to afford a greater extent of inland navigation, probably, than exists in all the rest of Europe. Its superficial extent, including Poland, is about 1,687,000 square English miles, which is more than eight times the area of France, or fourteen times that of the British Isles. But of this surface more than one-fourth part, lying beyond the parallel of 60° is incapable of cultivation, from the rigour of the climate, or the marshy nature of the soil. In the south, also, there are vast sandy plains, the soil of which, destitute of wood and water, and impregnated with salt, is altogether useless for agriculture. The fertile part of Russia consists chiefly of the country lying between the parallels of 50° and 57°, which contains a great proportion of excellent soil, well watered with navigable streams, and comparatively populous and cultivated. The cultivation of wheat is chiefly confined to this region, and here abundant crops are procured with little labour, and by a very rude species of culture. But farther north, slender crops are obtained with so much exertion, that a single peasant cannot cultivate more than from seven to ten acres; and these crops are so precarious, that the rye sometimes will not ripen in the neighbourhood of Petersburg. The lands, however, where corn will not grow, yield pas-

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ture and wood. Trees are found as far as the 67th degree, beyond which there are only shrubs. *

It has been computed, that the soil incapable of cultivation in European Russia amounts to 690,000 square English miles, or 40 parts in the 100 of the whole surface. (Mentelle et Malte-Brun, II. 69.) The annual produce of corn in all Russia has been estimated at 181,000,000 tchetverts, including seed, equal to 126,000,000 quarters, and valued at 371,000,000 of rubles. But this estimate is evidently a gross exaggeration. The crown forests are estimated at 44,500,000 of desiatines, equal to 240,000 square miles. Rye is the grain most extensively cultivated all over Russia; but barley, wheat, and oats, are also raised. In the southern provinces, maize, rice, vines, and even cotton succeed; and both in the southern and central parts, vast ranges of pasture ground support numerous herds of cattle, the skins and tallow of which, with the peltries of wild animals, are leading articles of exportation. These pastures are generally commons: the quantity of uncultivated lands, says Storch, is so great, that it would be useless to divide them. The number of sheep in Russia has been estimated at 60,000,000. Flax and hemp, however, are the productions in which the soil of Russia has the greatest superiority, and of these she exports great quantities. Some of the less civilized nations are almost supported by bees, and wax and honey are also among the principal articles of exportation. The annual produce of raw silk in Russia is estimated at 10,000 pounds. Russia has rich mines of gold, silver, copper, iron, lead, and salt, the best of which are in the Uralian mountains, and chiefly on the Asiatic side. They employ about half a million of persons. Their annual produce is valued at 17,147,000 silver rubles, of which the crown receives 6,463,535 rubles. It consists of 1600 pounds of gold, 52,000 pounds of silver, 81,000 centner of copper, 18,181 centner of lead, and 6,224,692 centner of iron. The salt mines yield 8,000,000 centner of salt annually. The fisheries are supposed to employ a capital of 6,657,000 rubles, and to yield an annual gain of 2,200,000. (Crome, p. 58, 64, 67.)

The manufactures of Russia are inconsiderable, though the government has made great exertions to encourage this species of industry. The principal are those of coarse woollens, flax, iron, leather, silk, glass, and brandies. The manufacturing establishments, in 1812, amounted to 2331, and employed from 600,000 to 700,000 persons. In 1815, the number was 3262, of which 181 were for cloth, 150 silk, 1348 leather, 247 soap, tallow, and wax, 184 linen, 295 cotton, 138 glass, 200 metal. (Crome, p. 70.)

The exports of Russia, in 1796, including the goods carried out by land, and by the Caspian Sea, which do not appear in the customhouse returns, were estimated at 50,000,000 of rubles (Storch, II. 421); which is equal to L. 8,330,000, if the silver ruble is meant; or L. 5,870,000, if the paper ruble. In 1805, the exports were 72,400,000 rubles. The number of merchants was estimated at 97,227, and their trading capital at 308,000,000 rubles. The internal traffic between China, Siberia, and Moscow, employs 38,000 persons as carriers. (Crome, p. 73.)

If confidence might be put in the lists transmitted to government, the annual mortality in Russia is only 1 in 58, the births 1 in 26, and the annual addition to the population 1 in 49, so that the period of doubling should be 35 years. (Storch, I. 282.) But these extraordinary results are irreconcilable with facts. The population in 1783, according to Storch, was 27,397,000; and the highest estimates only make it amount to 42,722,000 in 1815, excluding the kingdom of Poland. (Hassel, p. 223.) Deducting about 6,000,000, added to the empire by conquest, the real increase, in 32 years, is only 9,425,000; and the period of doubling, calculated on this basis, would be 75 years, a rate of increase not greater than was exemplified in Silesia, and in Britain during the last 40 years. Russia, however, has ample room to allow her population to expand, as her soil in Europe would easily support 100,000,000; while the increase in other countries must be confined within narrow limits. There are in Russia above 80 nations, who speak more than 40 different languages; but the Sclavonic race forms seven-eighths of the whole European population. According to the official returns in 1783, the peasants, belonging to the crown and to the nobles, amounted to 83 persons in the 100 of the whole population. (Storch, I. 249.) Of the 45,500,000 of inhabitants, the Sclavonic race forms 38,000,000, the Finns 2,376,000, the Tartars 1,850,000, the Caucasian tribes 1,200,000, Monguls 300,000, colonists, including Moldavians, French, Germans, &c. 800,000. About one ninth of the people live in towns. (Hassel, p. 223; Crome, p. 61.) The army, in 1815, amounted to 621,155; the navy to 32 ships of the line, and 18 frigates; the revenue is about L. 25,000,000 Sterling. The public debt at the end of the war was about 600,000,000 rubles; the greater part, however, paper money. (Crome, 78, 80; Hassel, 226.) Of all the powers of Europe, Russia is the only one that, during the numerous changes of the last thirty years, has never lost any part of her territories; but has been continually adding to them. Her acquisitions since 1770 are as follows:

	Square Miles.	Population.
1772, First partition of Poland,	33,000	1,226,000
1793, Second do. do.	90,000	3,745,000
1795, Third do. do.	42,000	1,407,000
1774 to 1791, From the Porte,	60,000	2[illegible]4,000
1807, District of Bialystock, from Prussia, - -	4,200	183,000
1809, District of Tarnopol, ceded by Austria, containing 400,000 inhabitants, but restored in 1815.		
1809, Finland and Lapmark from Sweden, - -	120,000	895,000
1811, Part of Moldavia and Bessarabia from the Porte, -	13,000	230,000
1814, Duchy of Warsaw, † now the kingdom of Poland,	47,400	2,793,000
Total acquisitions of Russia since 1770 in Europe, -	409,600	10,683,000

* Storch, *Tableau*, I. 4; II. 209, 229, 231; Crome, *Ubersicht*, 55.

† Under the French rule, the Duchy of Warsaw included Posen, and part of the district of Netz, making

SWEDEN.

Sweden has sunk in her relative importance in consequence of the rise of Russia, but she still holds a higher place in the scale of power than any other European state with an equal population. Now that Norway is united to her dominions, she has the best military and commercial position of all the northern continental powers. But the soil is poor and rocky, so that, though her territories form one-tenth of the surface of Europe, her population amounts to less than one-fiftieth. Her principal wealth consists in her rich mines of iron and copper, and in the produce of her forests, and her fisheries.

The agricultural produce of Sweden, which does not suffice for her own consumption, consists chiefly of rye, oats, barley, and potatoes; the soil and climate not admitting of wheat, except in the southern parts. Gothland, the most fertile province, contains one-half of the population upon less than one-fifth of the surface of the kingdom. The soil actually in cultivation in Sweden in 1810 amounted only to 1,091,000 tunnas, or 1,363,838 acres; but the soil capable of cultivation was estimated at 1,818,450 acres, or one sixty-second part of the surface of the country. This is the average of the whole; but in the province of Norland only 1 acre in 915 is arable. The lakes cover one eighteenth part. The pasture ground and gardens occupy about twice the quantity of land under corn. The average size of a farm is only about 27 acres. The whole annual produce of grain is estimated at 5,702,835 spans, equal to about 1,482,500 quarters, besides 350,000 quarters of potatoes. The general produce of the crops is about 5 for 1. In Norway, the land in cultivation amounts to less than 1 acre in 100, and one-fourth of the grain used is imported. Potatoes are extensively cultivated. In times of scarcity bread is made of the bark of trees, and of the Iceland moss, on which the Reindeer feed. There were in Sweden, in 1810, about 403,700 horses, 1,475,700 black cattle of all kinds, and 1,212,700 sheep. The quantity of bar-iron manufactured in Sweden, in 1809, was 1,293,400 hundred weight, or 61,467 tons. This article forms seven-eighths of the whole Swedish exports. The annual produce of copper is 7546 skippund, or about 1000 tons; of lead, 14 tons; silver, 2730 marks; of gold, 10 marks. The mines employ about 50,000 persons. Of 24 counties, the 13 which abound most in forests contain 103,000 square English miles of woodland, while the annual consumption for all purposes in Sweden is computed to require only 2600 square miles. Sweden exports wood to the value of 900,000 dollars, and Norway to the value of 5,000,000 dollars yearly. (Crome, 98, 102, 119. Thomson's *Travels*, 392—431.)

The manufactures of Sweden are of little importance. Sixty or seventy ships are built annually and sold to foreigners. The distillation of brandy consumes 700,000 spans of corn a-year. The manufactures of paper and glass and works in metal supply the internal consumption; those of cotton, wool, and silk, are of small extent. The whole produce of manufactures in Sweden (exclusive of Norway), in 1814, was valued, in an official statement, at 5,622,129 dollars banco, or about L. 800,000. (Crome, 123.)

The exports of Sweden, in 1816, were estimated at seven millions of dollars, (exclusive of Norway), and the imports at no less than twenty millions. The supposed national loss arising from this disproportion, led to a prohibition of the importation of wine, rum, cotton stuffs, and other articles considered as luxuries. In 1816, Sweden had 1107 merchant ships, amounting to more than 64,000 lasts, or 120,000 tons of tonnage. (Crome, 122, 125.)

The population of Sweden was estimated at 2,615,800 in 1818; that of Norway, in 1803, was 910,000, and from the probable rate of increase there, may now amount to nearly one million. In Sweden about one-ninth and in Norway about one-twelfth of the people live in towns. This increase in numbers has been attended with an improvement in the condition of the inhabitants. The annual mortality in Sweden, which Malthus, in 1796, estimated at 1 in 37, was, in 1811, according to Akrell, 1 in 40 for the southern parts, 1 in 47 for the northern, and 1 in 43 for the whole kingdom. In Norway the mortality has always been smaller than in any other European country. In 1815 the nobles amounted to 1641 families, or 9523 persons, the clergy, including their families, to 15,202, the burghers to 64,755, and the peasants to 1,763,397. Besides these classes, who are represented in the diet, there are about 500,000 persons not represented, consisting of civil and military officers, miners, mechanics, servants, &c. 153,797, or about one-fourth of the peasants who are householders, farm their own lands. The established religion is Lutheran, and the number of parochial clergymen in Sweden is 1094, besides 170 prebends, 11 bishops, and 1 archbishop; and the tithes amount to 283,232 spans, or about 72,500 quarters of corn. Norway has 467 clergymen, including 5 bishops. (Crome, 96, 116. Thomson's *Travels*, 418.)

Subsequent to the revolution in 1809, some improvements have been made in the constitution, by enlarging the powers of the diet. The four estates of nobles, clergy, burghers, and peasants, who sit in separate houses, meet necessarily at the end of five years, or oftener if convoked by the king. The consent of three of these houses, with that of the king, gives a proposition the force of law. No taxes can be raised without the authority of the diet, and the persons of the members are inviolable during the session. The conscription, which was introduced in 1809, subjects all males between 20 and 25 to military service; and the nobles have been deprived of the exemption they formerly enjoyed from this service and from taxes. The press is declared by the constitution to be free, but is in fact under the control of the police. The revenue of Sweden and Norway

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its extent 65,000 square miles, and its population 3,800,000. The total acquisitions of Russia in Poland amount to about four-fifths of the country, and three-fourths of the population. (Hassel, *Allg. Europ. Staats*, Mentelle et Malte-Brun, *Geog. et Atlas*; Storch, *Tableau*.)

Europe. is about L. 1,500,000. The debt of Sweden, in 1816, was 10,209,611 dollars banco, or about L. 1,480,000, and Norway also owes a considerable sum. The army for both countries, in 1817, consisted of 53,560 men: the navy about 20 ships of the line, and 16 frigates. (Crome. p. 131-137. James's *Travels*, I. 281.)

The acquisitions and losses of Sweden, since 1789, may be stated thus:

	Square Miles.	Inhabitants.
1809, Lost Finland and Lapmark, conquered by Russia,	120,000	895,000
Pomerania,	1,480	120,000
	121,480	1,015,000
1813, Acquired Norway by cession from Denmark,	148,000	950,000
Absolute gain of territory and loss of population,	26,520	65,000

Spain.

The vast natural resources of this country present a striking contrast with its political imbecility. It is nearly as large as France, but contains little more than a third of the population, though its fertile soil and delicious climate yield in abundance the productions both of the temperate and warm regions of the globe. With its great extent of sea-coast, numerous rivers, and excellent position for trade, and its rich and extensive colonies, nothing but extreme misgovernment could have prevented it from becoming the first commercial state in the world.

In addition to silk, tobacco, vines, olives, and all the agricultural productions of France and Germany, Spain produces the orange, citron, sugar-cane, cork tree, dates, figs, and cotton. Wheat is the grain most extensively cultivated. Barley and rye are next in quantity. Very few oats or potatoes are raised, but considerable quantities of maize and rice. Hemp to the value of a million of piastres is raised yearly; and flax is cultivated on a smaller scale. The vineyards, besides supplying the internal consumption, furnish 3,000,000 or 4,000,000, or, according to other accounts, 10,000,000 or 11,000,000 gallons of wine for exportation, and half as much brandy. Olive oil is exported to the value of L.600,000 a-year. The annual produce of raw silk is valued at L.300,000. But wool is the produce for which Spain is most celebrated. The number of merinos or migratory sheep, which furnish the finest wool, is estimated at 5,000,000; those that are stationary at 8,000,000; and these 13,000,000 of sheep are supposed to afford yearly 45,000,000 of pounds of wool. The right of pasture which the migratory flocks have over whole provinces, is one great obstacle to agricultural improvement. From this and other causes, one-third or one-half of the kingdom is left entirely waste, and the part in cultivation is wretchedly managed. Nearly the whole land in the kingdom is locked up by entails in the hands of the nobles and the clergy, and the small portions brought into the market sell so high as not to afford more than one and a half *per cent.* upon their price. Agriculture is entirely in the hands of the peasantry, who are poor and ignorant; men of capital never engage in it; and the grandees, who should support and encourage improvements, all reside in the large towns. In the whole of Spain, there is scarcely to be seen a villa or gentleman's seat, except a few that are in ruins. The mines of Spain, like her agriculture, are neglected; but she still derives from her own soil a considerable supply of iron, copper, lead, and mercury. About 5,000,000 centners of salt are annually obtained from mines, springs, or the sea. *

The greatest number of the Spanish manufactures are in Catalonia, but a few are scattered through the other provinces. The most considerable are the woollen, silk, linen, cotton, hemp, leather, paper, and metal, but none of them are sufficient for the internal consumption of the country, and all of them are fettered by vexatious taxes, absurd regulations, and the difficulty of intercourse between the provinces. The manufacture of tobacco is a royal monopoly. (Laborde, IV. 320.)

We have no accurate accounts of the commerce of Spain for a recent period. The exports in 1788 were L.6,951,000, of which rather more than the half went to America. (Laborde, IV. 410.) In 1802, the exports were estimated by Malte-Brun at 240,000,000 francs, or nearly L.10,000,000 Sterling. (Mentelle et Malte-Brun, *Geog.* II. 31.)

It is now pretty well ascertained, that the apparent decline of Spain has been the consequence of the rapid progress of her neighbours; and that, down to the end of the eighteenth century, she was advancing both in industry and population. From a combination of circumstances, the causes which check the progress of society have operated more powerfully there than in any other country of Europe except Turkey. Among the greatest evils in the state of the country may be reckoned the excessive number of the nobility and clergy, with their oppressive privileges, and their pernicious influence upon the other classes. In 1788, when the population amounted to 10,500,000, the number of the secular and regular clergy was 147,722, of the nobles 478,716, of peasants and labourers 1,847,010, of manufacturers and handicrafts 302,000, servants 276,090, merchants 34,030. The Spanish army, in 1806, consisted of 153,840 men in Europe, and 129,053 in America; the navy consisted of 42 ships of the line, and 30 frigates. In 1804, the revenue, according to Humboldt, was 43,000,000 piastres, or L.9,150,000. In the Budget for 1818, it is estimated at L.8,248,000, and the expenditure at L. 9,611,000. The debt in 1809 was stated to amount to L. 43,100,000, and in 1817 to L.127,852,000. †

Germany.

In the early part of the eighteenth century, Germany consisted of about 300 Sovereign States, great and small, which were united into one empire by

* Laborde's *View*, I. 102, 116, IV. 51, 83. Crome, 271-276.

† Laborde, IV. 25; Hassel, *Allg. Europ. Staats*, 313; Crome, 295; Humboldt's *New Spain*, IV. 240.

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Europe.

a very complicated constitution. From time to time some of the smaller principalities have been suppressed and incorporated with the larger states; but the first radical change in the composition of the Germanic body was made by the treaty of Luneville, 9th February 1801, when a vast number of bishoprics, abbeys, and free towns, were deprived of their rights of sovereignty, and given as indemnities to princes who had lost their possessions in Belgium and Italy by the French conquests. In 1806, the Emperor Francis formally renounced the dignity of head of the empire; the ancient constitution of the empire was dissolved, and a new league formed with France at its head (see CONFEDERATION OF THE RHINE), comprehending the most considerable states in the south, to which those in the north were afterwards added. This confederation fell to pieces on the overthrow of the French power in 1813, but it has served as the foundation of the new constitution of the Germanic body. The number of states is now reduced to 39, including Austria, Prussia, Denmark, and the Netherlands; but these four powers rank as members only for a part of their dominions. The ecclesiastical principalities are entirely abolished; and the free towns, of which there were 47 or more in 1800 (Hoeck's *Tables*), are now reduced to four. The princes who have lost their sovereignty have been reduced to the rank of nobles, and no longer holding immediately of the empire, are said to be *mediatised*. The titles of royalty conferred by Bonaparte upon Bavaria, Wirtemberg, and Saxony, have been confirmed, and Hanover has since been raised to the same rank. The common concerns of this confederacy are managed by a diet, consisting of deputies from thirty-eight states (Hesse Homberg having no vote), who meet at Frankfort. The pecuniary contributions, fixed in proportion to the population of each state, are voted for a period of five years. The military contingents, which are regulated on the same principle, amount to 120,000 men in time of peace, and 301,000 in time of war, the latter being at the rate of 1 in the 100 of the population. The German states, including $\frac{2}{5}$ths of Austria, $\frac{4}{7}$ths of Prussia, besides Holstein and Luxemburgh, embrace an era of about 237,000 English square miles, with 30,095,050 inhabitants; of whom about 15,500,000 are Catholics; 12,000,000 Lutherans; 2,100,000 Reformed; 25,000 Moravians; 14,000 Greeks; and 182,000 Jews. The new Germanic constitution, though less complicated than the old, can scarcely be expected to produce any of the effects of a solid union in such a heterogeneous mass. The states are too unequal in strength to have a proper reciprocal influence, and there is not weight enough in the minor members to control the rival interests and jealousies of Austria and Prussia. The confederation may be considered as recognizing, and in some degree regulating, the influence which the greatest states must necessarily exercise indirectly over the smaller. (Hassel, I. 17. *Public Journals.*)

The following Table exhibits the result of the various changes since the commencement of the French Revolution, upon the principal members of the Confederation; but to enter into particulars would carry us beyond the proper limits of this article. Most of them (except Saxony) have been enriched by the breaking up of the ecclesiastical principalities.

	Before the Revolution.		In 1816.	
	Square Miles.	Population.	Square Miles.	Population.
Bavaria, -	22,000	2,183,000	30,000	3,560,000
Saxony, -	14,800	2,104,000	7,200	1,200,000
Hanover, -	10,900	787,000	14,400	1,305,000
Wirtemberg,	3,200	608,000	8,200	1,395,463
Baden, -	1,370	177,000	5,800	1,001,700
Hesse Cassel,	3,340	443,500	4,300	540,000
Hesse Darmstadt,	2,180	249,700	4,100	619,500
Oldenburgh,	960	95,000	2,500	217,000

(Hoeck, *Apercu.*—Hassel, *Europ. Staats*, 1816.)

Since the Congress of Vienna, many political changes of much importance have taken place in Germany; and, from the state of the public mind, it is evident that many more are in progress; but it does not belong to the objects of the present article to enter upon these subjects.

Smaller States.

The most important details regarding the *smaller states* will be found in the subjoined Table, which exhibits a view of the extent, population, revenue, military force, and religion, of all the sovereign states of Europe.

With respect to the authorities for this Table we may mention generally, that the extent assigned to Russia was ascertained, by measurement, on Arrowsmith's Map, and the other numerical statements respecting that country are taken from Hassel and Crome. All those relating to Austria are taken from Lichtenstern; those relating to Prussia from Demian and Hassel; those relating to France from Chaptal, Hassel, and Public Journals; those relating to Britain from Colquhoun, Sinclair, and Parliamentary documents, except the amount of the population, which is calculated on the basis of the returns in 1801 and 1811. Most of the others are from Hassel and Crome; except the statements of the population and military force of the small German States (No. 23), which are taken from a paper published by the Diet in 1818, fixing the military contingents of each state. These contingents are for a period of war, whereas the numbers given in the preceding part of the table represent the military peace establishments of the respective states. But as most of the German States keep up a greater number of troops than required by the act of the Diet, the numbers given in the table will not actually exceed the military force of these states in time of peace. (B. B. B.)

STATES.	Extent in English Square Miles.	Population.	Inhabit. to each Sq. Mile.	Revenue in Pounds Sterling.	Military Force.	Religion.
Europe,	3,431,953	184,060,500	54	182,868,550	1,715,794	
1 Russia in Europe, (Asiatic Russia, 5,820,000 sq. miles, with 8,376,000 of inhab.)	1,640,000	34,400,000	21	25,000,000	450,000	In the whole empire. 34,000,000 Greek Church. 5,300,000 Catholics. 2,500,000 Lutherans. 33,000 Reformed. 70,000 Armenians. 1,800,000 Mahometans. 210,000 Jews. 800,000 Lama worshippers.
Kingdom of Poland,	47,400	2,793,000	59	——	——	
2 France with Corsica,	204,000	29,327,000 (1817)	143	37,568,000 (1819)	140,000	25,633,000 Catholics. 2,300,000 Reformed. 1,100,000 Lutherans. 60,000 Jews.
3 Austria. Inhabitants. Austria Proper, 4,457,692 Bohemia, 3,236,140 Moravia and Silesia, 1,733,319 Galicia, 3,716,692 Hungary, 10,974,743 Lombardy, 4,089,294	258,000	28,207,880	109	22,000,000	290,000	21,631,000 Catholics. 3,421,000 Greek Church. 1,364,000 Reformed. 1,332,000 Lutherans. Besides Jews, Turks, Armenians, Mennonites, &c.
4 Britain. England (1811), 10,180,615 Scotland, 1,805,688 Ireland, 4,500,000 Army and Navy, 640,000	118,000	18,740,000 (1819)	158	55,741,000 (1818)	104,369	Episcopalians. Catholics. Presbyterians. Methodists. Baptists, Quakers, &c.
5 Prussia,	105,800	10,315,000 (1815)	97	7,000,000	175,000	6,242,000 Lutherans. 3,500,000 Catholics. 250,000 Reformed. 75,000 Jews.
6 Spain,	190,000	10,500,000	55	6,000,000	117,000	Catholic.
7 Turkey in Europe, (In Asia and Africa, 14,590,000)	197,000	6,700,000	34	3,000,000	110,000	Mahometans. Greek Christians. Armenians, &c.
8 Naples. Naples Proper, 4,963,502 Sicily, 1,655,536	43,500	6,619,036 (1815)	152	2,400,000	24,000	Catholic.
9 Netherlands. Dutch provinces, 2,016,159 Belgic ditto, 3,249,841	24,800	5,266,000 (1818)	212	6,728,000	40,000	In Dutch provinces chiefly Reformed. In Belgian chiefly Catholic.
10 Sardinia,	27,200	3,974,000	147	2,200,000	15,000	Catholic.
11 Portugal,	41,000	3,683,000	90	2,500,000	16,000	Catholic.
12 Sweden and Norway,	340,000	3,600,000	10	1,500,000	53,560	Lutherans, with a few Reformed, Jews, &c.
13 States of the Church,	16,200	2,425,000	149	930,000	2,000	Catholic.
14 Switzerland—22 Cantons,	19,000	1,745,750	91	430,000	15,000	Reformed. Catholic.
15 Denmark, Iceland and Feroe,	21,000 30,000	1,205,110 53,300	57 $1\frac{2}{3}$	1,120,000	28,000	Chiefly Lutheran. A few Reformed.
16 Tuscany, *Grand Duchy*,	8,400	1,195,000	142	500,000	6,000	Catholic.
17 Modena, *Duchy*,	2,050	396,000	193	120,000	2,400	Ditto.
18 Parma, Placentia, and Guastalla, *Duchy*.	2,260	376,500	166	150,000	2,400	Ditto.
19 Ionian Islands, *Republic*,	980	230,000	234	96,550	4,000	Greek Catholic.
20 Lucca, *Duchy*,	430	124,000	288	65,000	800	Catholic.
21 Cracow, *Free Town*,	406	61,000	—	20,000	——	Catholics. Lutherans. Jews.
22 St Marino, *Republic*,	42	6,000	—	5,000	——	Catholic.

STATES.	Extent in English Square Miles.	Population.	Inhabit. to the Sq. Mile.	Revenue in Pounds Sterling.	Military Force.	Religion.
23. German States, exclusive of Austria, Prussia, Denmark, and the Netherlands.					Contingents fixed by Diet	
Kingdoms.						
1. Bavaria, . . .	30,000	3,560,000	118	1,900,000	35,600	Majority Catholics. 780,000 Lutherans. 5,000 Reformed. 16,000 Jews.
2 Wirtemberg, . . .	8,200	1,395,463	170	1,000,000	13,955	Chiefly Lutherans. Some Catholics.
3. Hanover, . . .	14,400	1,305,000	90	950,000	13,050	Majority Lutherans. 152,000 Catholics. 38,000 Reformed.
4. Saxony, . . .	7,200	1,200,000	169	900,000	12,000	Chiefly Lutherans. A few Catholics. Royal Family Catholic.
Principalities, Duchies, &c.						
5. Baden, . . .	5,800	1,001,700	169	550,000	10,000	620,000 Catholics. 305,000 Lutherans. 61,000 Reformed. 15,000 Jews. Prince's family Lutheran.
6. Hesse Darmstadt, . .	4,100	619,500	151	369,000	6,195	$\frac{4}{7}$th Lutherans. Catholics. Reformed.
7. Hesse Cassel, .	4,300	540,000	125	380,000	5,400	324,870 Reformed. 143,800 Lutherans. 72,800 Catholics. 8,300 Jews.
8. Mecklenburg, Schwerin,	4,800	358,000	75	175,000	3,580	Chiefly Lutheran.
9. Nassau, . .	2,200	302,767	137	176,000	3,028	Lutheran, Catholic, Reformed, pretty equally.
10. Oldenburg, . .	2,500	217,769	85	126,000	2,178	Chiefly Lutheran.
11. Brunswick, . .	1,540	209,600	137	167,000	2,096	205,262 Lutherans. 2,072 Catholics. 1,046 Reformed.
12. Saxe Weimar, .	1,430	201,000	140	150,000	2,010	Chiefly Lutheran.
13. Saxe Gotha, . .	1,170	185,682	159	150,000	1,875	do.
14. Saxe Coburg, .	580	80,012	148	52,500	800	do.
15. Mecklenburg Strelitz, .	875	71,769	82	70,000	718	do.
16. Lippe Ditmold, .	510	69,062	135	46,500	691	Reformed. Lutheran.
17. Saxe Meiningen, .	385	54,400	141	35,000	544	Chiefly Lutheran.
18. Schwartzburg Rudolstadt,	365	54,647	145	22,000	529	Reformed. Lutheran.
19. Anhalt Dessau, .	470	53,937	115	51,000	539	Chiefly Lutheran.
20. Reuss, younger branch,	430	52,205	121	42,000	522	do.
21. Waldeck, . .	450	51,877	115	48,000	519	do.
22. Schwartzburg Sondershausen,	490	45,117	90	27,500	451	do.
23. Anhalt Bernburg, .	345	37,046	107	39,000	370	Reformed. Lutheran.
24. Hohenzollern Sigmarigen,	428	35,360	82	24,000	353	Catholic.
25. Anhalt Kothen, .	320	32,454	101	23,000	325	Reformed. Lutheran.
26. Saxe Hilburgausen, .	235	29,706	126	15,000	297	Chiefly Lutheran.
27. Lippe Schaumburg, .	214	24,000	112	21,500	240	Reformed. Lutherans.
28. Reuss, elder branch, .	150	22,255	148	13,000	223	Chiefly Lutheran.
29. Hesse Homberg, . .	——	20,000	—	17,000	200	———
30. Hohenzollern Hehingen,	107	14,500	135	8,000	145	Chiefly Lutheran.
31. Lichtenstein, . .	54	5,546	103	5,000	55	Catholic.
Free Towns.						
32. Hamburg, . .	134	129,800	—	100,000	1298	Chiefly Lutheran.
33. Bremen, . .	75	48,500	—	40,000	485	Reformed. Lutheran.
34. Frankfort, . .	107	47,850	—	62,500	479	Chiefly Lutheran.
35. Lubeck, . .	118	40,650	—	37,500	407	do.

EXCHANGE.

Exchange.

In the science of Political Economy, the term Exchange is commonly understood to designate exclusively that species of mercantile transactions, whereby the debts of individuals, residing at a distance from each other, may be either partially or wholly liquidated, without the intervention of money. The object of this article is to explain the nature of these transactions, and the principles on which they are founded.

This will be best effected, by treating, *first*, of the exchange between different parts of the same country; and, *secondly*, of that between different and independent countries.

Inland Exchange.

Inland Exchange.

Suppose a merchant, residing in London, orders his agent in Glasgow to purchase a thousand pounds worth of cottons on his account; then, although it should not suit the Glasgow merchant to commission goods of equal value from his London correspondent, the latter may nevertheless be under no necessity of remitting cash to Glasgow to discharge his debt. Among cities, or countries, having a considerable intercourse together, the debts mutually due by each other are found, in ordinary cases, to be nearly equal. And, therefore, the Glasgow merchant, who has shipped the cottons for London, does not transmit the bill, drawn by him on his correspondent for their price, directly to London to be cashed, for that would subject him to the expence of conveying the money home from London to Glasgow, but he gets its value from *some other merchant in Glasgow*, who has payments to make in London, on account of teas, wines, &c. imported from that city, and who, unless he could procure such a bill, would be obliged to remit their price in money. The bill on account of the cottons is, therefore, either drawn in favour of the person to whom the money for the tea and wine is owing in London, or it is drawn in favour of the tea merchant in Glasgow, and indorsed to him; and this last person, by presenting the bill to the purchaser of the cottons, receives its value, and consequently the price of the cottons, and the price, or part of the price, of his tea and wine at the same moment. By this simple contrivance, therefore, the expence and risk attending the double transmission, first, of money from London to Glasgow to pay the cottons, and, second, of money from Glasgow to London to pay the teas and wines, is entirely avoided. The debtor in one place is changed for the debtor in the other; and both accounts are settled without the intervention of a single farthing.

Inland Exchange.

The bill drawn and negociated in such a transaction as this, is termed an *inland* bill of exchange. If the transaction had taken place between London or Glasgow and a foreign city, it would have been termed a *foreign* bill of exchange.

A bill of exchange may, therefore, be defined to be, "An order addressed to some person residing at a distance, directing him to pay a certain specified sum to the person in whose favour the bill is drawn, or his order." *

Circumstances which determine the Price of Inland Bills of Exchange.

The price of bills of exchange fluctuates according to the abundance or scarcity of them in the market, compared with the demand. Thus, to revert to our former example, if we suppose the debts reciprocally due by London and Glasgow to be equal, whether they amount to L.10,000, L.100,000, or any other sum, they may all be discharged without the agency of money, and the price of bills of exchange will be at PAR; that is, a sum of L.100 or L.1000 in Glasgow will purchase a bill for L.100 or L.1000 payable in London, and *vice versa*. But if these two cities are not mutually indebted in equal sums, then the price of bills of exchange will be increased in the city which has the greatest number of payments to make, and will be proportionably reduced in that which has the fewest. If Glasgow owes London L.100,000, while the debts due by London to Glasgow only amount to L.90,000, it is clear, inasmuch as the merchants of Glasgow have a larger sum to remit to London, than the merchants of London have to remit to Glasgow, that the price of bills on London would rise in Glasgow, because of the increased competition; and that the price of bills on Glasgow would fall in London, because of the proportionably diminished competition. And hence a larger sum would be required to discharge any given amount of debt due by Glasgow, and a less sum would be required to discharge a corresponding amount of debt due by London; or, which is the same thing, the exchange would be in *favour* of London, and *against* Glasgow. Bills on London would sell in Glasgow for a *premium*, and bills on Glasgow would sell in London at a *discount*, the amount of the premium in the one case, and of the discount in the other, being obviously equal.

On the supposition, that the balance of L.10,000, due by Glasgow, depressed the exchange of that city on London *one per cent.*, it would at first sight appear as if it would cost Glasgow L.101,000 to discharge its debt of L.100,000 due to London; and that, on the other hand, L.89,108 would be sufficient to discharge the debt of London to Glas-

* In mercantile phraseology, the person who draws a bill is termed the *drawer;* the person in whose favour it is drawn, the *remitter;* the person on whom it is drawn, the *drawee*, and after he has accepted, the *acceptor*. Those persons into whose hands the bill may have passed previous to its being paid, are, from their writing their names on the back, termed *indorsers;* and the person in whose possession the bill is at any given period, is termed the *holder* or *possessor*.

Inland Exchange.

gow. But a very little consideration will serve to show that this could not really be the case. No exchange transactions can take place between different cities, until there be both debtors and creditors of the one residing in the other. And hence, when the exchange became unfavourable to Glasgow, the premium paid by the Glasgow merchants for bills drawn on London would not go into the pockets of their creditors in that city, but into the pockets *of their neighbours in Glasgow, to whom London was indebted*, and from whom the bills had been purchased. The loss to Glasgow would, therefore, be limited to the *premium* paid on the balance of L. 10,000. Thus, supposing that A of Glasgow owes D of London L. 100,000, and that C of London owes B of Glasgow L. 90,000, A will pay to B L. 91,000 for a bill, or order, on C to pay D L. 90,000. In this way, the L. 90,000 London debt at Glasgow would be quite cleared off; the premium, which is lost by the debtor to London in Glasgow, being gained by its creditor in the same place. If the business had been transacted in London, C, with L. 89,108, would have purchased of D a bill for L. 90,000 payable by A, so that, in this case, the gain would have fallen to the share of the debtor C, and the loss to that of the creditor D, both of London. The complexity of real transactions does not affect the principles on which they are founded; and to whatever extent Glasgow might be indebted to London, or London to Glasgow, the only disadvantage under which either of them would in consequence be placed, would be the unavoidable one of paying the expence of remitting the *balance* of debt.

Natural limit to fluctuations in the Exchange.

The expence of transmitting money from one place to another forms the natural limit to fluctuations in the exchange. If 20s. sufficed to cover the expence and risk attending the transmission of L. 100 from Glasgow to London, it would be indifferent to a Glasgow merchant, whether he paid one *per cent. premium* for a bill of exchange on London, or whether he remitted money direct to that city. If the premium was less than one *per cent.*, it would be clearly his interest rather to make his payments by means of bills of exchange than by remittances; and that it could not exceed one *per cent.* is obvious, for every individual would rather directly remit money, than incur an unnecessary expence, by purchasing a bill on London at a greater *premium* than would be sufficient to cover the expence attending a money remittance. If, owing to the badness of the roads, to disturbances in the country, or to any other cause, the expence of remitting money from Glasgow to London should be increased, the difference in the rate of exchange between these two cities *might* also be proportionably increased. But in every case, the extent to which this difference could attain, would necessarily be limited by, and could not, for any considerable period, exceed the cost of making remittances in cash.

Exchange transactions become more complex, when one place, as is very often the case, discharges its debts to another by means of bills drawn on a third place. Thus, although London should owe nothing to Glasgow, if Glasgow is indebted to London, London to Manchester, and Manchester to Glasgow; Glasgow would either wholly or partially discharge its debt to London by a bill drawn on Manchester. It would wholly discharge it, provided the debt due to Glasgow in Manchester was equivalent to the debt due by Glasgow to London. But if this be not the case, Glasgow must either remit money to London to discharge the *balance* of debt, or bills drawn on some other place indebted to her.

Transactions in inland bills of exchange are almost entirely conducted by bankers, who charge a certain rate *per cent.* for their trouble, and who, by having a credit in those places to which they are in the habit of remitting bills, are enabled, on all occasions, to supply the demands of their customers. In Great Britain, London, because of its intimate connection with other parts of the country, occasioned partly by its immense commerce, partly by its being the seat of government, and the place to which the revenue is remitted, and partly by its currency consisting of Bank of England paper, for which the paper currency of the country banks is rendered exchangeable, has become the great focus in which all the money transactions of the empire center, and in which they are ultimately adjusted. In consequence of these various circumstances, but chiefly of the demand for bills on London to remit revenue, and of the superior value of Bank of England currency, the exchange between London and the other parts of the country is invariably in its favour. Bills on London drawn in Edinburgh and Glasgow were formerly made payable at 40 days' date, which is equivalent to a *premium* of about $\frac{1}{2}$ *per cent.*; but, owing to the greater facility of communication, this *premium* is now reduced to 20 days' interest, or to about $\frac{1}{4}$ *per cent.* Bills for remitting the revenue from Scotland are now drawn at 30 days; previously to summer 1819 they were drawn at 60 days.

What has been already stated is sufficient to show, that, however well fitted bills of exchange may be for facilitating the operations of commerce, and saving the trouble and expence attending the transportation of money, it is impossible to adjust mercantile transactions by their means, except in so far as the accounts mutually balance each other. A *real* bill of exchange is merely an order entitling the holder to receive payment of a debt *previously contracted* by the person on whom it is drawn. It is essential to the existence of such a bill that an equivalent amount of debt should first have been due. And hence, as the amount of the real bills of exchange drawn on any one merchant, or body of merchants, cannot exceed the amount of the debts due by them, if a greater sum is owing them than what they owe to others, the *balance*, it is obvious, must either be paid in money, or by the delivery of some sort of commodities possessed of real value. If, as in the example just given, Glasgow owes London L. 100,000, while London only owes Glasgow L. 90,000, a reciprocal transfer of debts may be made to the extent of L. 90,000. But the Glasgow merchants cannot discharge the additional L. 10,000 by means of bills drawn on London; for, by the supposition, London only owed them L. 90,000, and they have already drawn for its amount. The balance, therefore, must either be discharged by an actual money payment,

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or by the delivery of some species of commodities, or by bills drawn on some third party who may be indebted to Glasgow.

Fictitious Bills of Exchange.

We do not mean by this to insinuate that there are no *fictitious* bills of exchange, or bills drawn on persons who are not really indebted to the drawer in the market. In every commercial country bills of this description are always to be met with; but they are only a device for obtaining loans, and do not and cannot transfer real debts. A merchant in London may form a connection with a merchant in Glasgow, and draw bills of exchange upon him payable a certain number of days after date, which the latter may retire by selling in Glasgow an equal amount of bills drawn upon his correspondent in London. The merchants who purchase, or the bankers who discount these bills, really advance their value to the drawers, who, as long as they continue, by means of this system of *drawing* and *redrawing*, to provide funds for their payment, continue in fact to command a borrowed capital equal to the amount of the fictitious paper in circulation. It is clear, however, that the negociation of such bills can have no effect in the way of transferring and settling the real *bona fide* debts reciprocally due between any two or more places. Fictitious bills mutually balance each other. Those drawn by London on Glasgow are exactly equal to those drawn by Glasgow on London, for the one set are drawn to pay the other—the second destroys the first, and the result is nothing.

The method of raising money by the discount, or, which is the same thing, by the sale of fictitious bills, has been severely censured by Dr Smith, as entailing a ruinous expence on those engaged in it, and as being resorted to only by projectors, or persons of suspicious credit. When fictitious bills are drawn at two months' date, there is, in addition to the ordinary interest of 5 *per cent.* a commission of about ½ *per cent.*, which must be paid every time the bill is discounted, or, at least, *six* times in the year. The total expence of money raised in this way could not, therefore, supposing the transaction to be always on account of the same individual, be estimated at less than 8 *per cent. per annum*; and the payment of so high a rate of interest on borrowed capital, in a country where the ordinary rate of mercantile profit is only supposed to average from *six* to *ten per cent.*, could not fail to be generally productive of ruin to the borrower. It seldom happens, however, that in transactions carried on by means of fictitious bills, the whole charge for commission falls on one individual. Loans obtained in this way are almost always on account of two or more persons. Thus, at one time a fictitious bill may be drawn by A of London on B of Glasgow; and, in this case, the Glasgow merchant will, before the bill becomes due, draw upon his London correspondent for the proceeds of the bill, including interest and commission. At another time, however, the transaction will be on account of B of Glasgow, who will then have to pay commission to his friend in London; so that each party may, on the whole, as Mr Thornton has observed, gain about as much as he pays in the shape of commission.

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It is often extremely difficult to distinguish between a fictitious bill and one which has arisen out of a real mercantile transaction. Neither does it seem to be of any very material importance. The credit of the persons whose names are attached to the bills offered for discount, is the only real criterion by which either a private merchant or a banker can judge whether he ought to negociate them. The circumstance of a merchant offering considerable quantities of accommodation paper for discount, ought, unquestionably, if discovered, to excite a suspicion of his credit. But unless in so far as the drawing of fictitious bills may be held to be indicative of overtrading, or of a deficiency of capital to carry on the business in which the party is engaged, there does not appear to be any good reason for refusing to discount them.

These few observations will, perhaps, suffice to explain the manner in which transactions between different parts of the same country are settled by means of bills of exchange. They are, in general, extremely simple. The uniform value of the currency of a particular country renders all comparison between the value of money at the place where the bill is drawn and negociated with its value where it is to be paid unnecessary; while the constant intercourse maintained between the different commercial cities of the same kingdom, by preventing those derangements to which the intercourse between distant and independent countries must always be subject, also prevents those sudden fluctuations which so frequently occur in the market price of foreign bills of exchange. We shall, therefore, leave this part of our subject, and proceed to investigate the circumstances which influence the course of exchange between different and independent countries.

Foreign Exchange.

Foreign Exchange.

The price of foreign bills of exchange depends entirely on two circumstances; *first*, on the value of the currency at the place where they are made payable, compared with the value of the currency at the place where they are drawn; and, *secondly*, on the relation which the supply of bills in the market bears to the demand.

If the real and nominal value of the currencies of the different nations having an intercourse together remained invariable, such fluctuations in the price of bills of exchange as arise from the first of these circumstances would be altogether unknown. But, as the comparative value of the pound Sterling, dollar, franc, guilder, florin, &c. is subject to perpetual variation, the price of bills of exchange must vary accordingly. Such variations, however, as proceed from this cause, affect merely their *nominal*, or rather numerical value. It is those only which arise from variations in the supply and demand for bills, or, which is the same thing, in the payments a country has to make compared with those it has to receive, that can be considered as *real*; and hence the distinctions of *nominal*, *real*, and *computed* exchange. The *first* depends on alterations in the relative value of the currencies to be compared together; the *second* depends on the supply of bills in the market

Nominal Exchange.

compared with the demand; and the *third*, or *computed* exchange, depends on the combined effects of the other two. For the sake of perspicuity, we shall treat of these separately.*

Section I.—*Nominal Exchange.*

Nominal Exchange.

Bullion being every where recognized as the standard currency of the commercial world, the comparative value of the currencies of particular countries must depend, 1*st*, On the relative value of bullion in those countries; and, 2*dly*, On the *quantity* of bullion contained in their coins, or on the quantity of bullion for which their paper-money, or other circulating media, will exchange.

Inquiry into the circumstances which regulate the value of Bullion in different Countries.

I. The real price of commodities being always proportionable not merely to the actual cost of their production, but also to the cost necessarily incurred in conveying them from where they have been produced to where they are to be made use of, it follows that, if the trade in the precious metals were perfectly free, and if the commodities produced in different countries were nearly all equally well fitted for exportation, the value of bullion in different countries would be chiefly regulated by their respective distances from the mines. Thus, on the supposition that neither England nor Poland had any other commodities except corn to exchange with the South Americans for bullion, it is evident that the precious metals would possess a greater value in Poland than in England, because of the greater expence of sending so bulky a commodity as corn, the more distant voyage, and because of the greater expence of conveying the gold to Poland. If Poland, however, had succeeded in carrying her manufactures to a higher pitch of improvement than England, her merchants might have been able, notwithstanding the disadvantage of distance, by exporting commodities possessed of great value in small bulk, and on which the expence of freight would have been comparatively trifling, to have sold bullion on cheaper terms than those of England. But if, as is actually the case, the advantages of skill and machinery were possessed by England, another reason would be added to that derived from her less distance from the mines, why gold and silver should be less valuable in England than in Poland, and why the money price of commodities should be higher in the former country. (Ricardo, *Principles of Political Economy, &c.* 1st Ed. p. 175.)

Hence, after nations have attained to different degrees of excellence in manufacturing industry, the value of bullion in different countries will no longer depend entirely on their distance from the mines. But, whatever variations a different progress in the arts may occasion in the value of bullion, as compared with particular commodities in different countries, it is certain that it must always be less valuable in those countries into which it is imported than in those in which it is produced. Bullion, like every other commodity, *is exported to find, not to destroy its level.* And, unless its value in Europe exceeded its value in America by a sum sufficient to cover the expences attending its importation, and to yield the ordinary rate of profit to the importer, we should not, although the mines of Mexico and Peru were a thousand times more productive than at this moment, be able to import a single ounce of bullion. It is obviously incorrect, therefore, to lay down as a general proposition, "that the *par* of exchange between two countries is that sum of the currency of either of the two, which, in point of intrinsic worth, is precisely equal to a given sum of the other, *that is, contains precisely an equal weight of gold and silver of the same fineness.*" (*Bullion Report*, p. 22, 8vo edit.) For a given quantity of gold and silver is not always, as is here assumed, of the same intrinsic value in different countries. It may not, indeed, differ very materially among nations in the immediate vicinity of each other, and which are all destitute of mines. But although, to use a familiar illustration, the value of sugar approaches nearly to a level in the great trading cities of Europe, it cannot surely be maintained, that its value, in the West Indies, is the same with its value in Bourdeaux or Liverpool, or that the exchange would be at true *par*, if a bill, which cost 100 hogsheads of sugar in London, only brought 100 in Jamaica. Now, this is precisely the case with bullion. Though the value of gold and silver, as compared with corn, labour, &c. may, and indeed must, vary very considerably among the different European nations, these variations are only the necessary result of their different progress in industry, and of the different quality of their cultivated lands, &c. Such a difference of prices is the natural order of things; and bullion has only found its proper level when a sufficient quantity has been introduced into those countries which excel in manufactures, so as to raise the price of their corn and labour. These variations have, therefore, no effect on the exchange. An ounce of bullion in one country, notwithstanding this difference of price, will, because of the facility of intercourse, be very near equivalent to an ounce of bullion in another; and, supposing the trade in the precious metals to be perfectly free, the exchange will be at true *par* when bills are negociated on this footing. But when we compare the value of the precious metals in very distant countries, and especially in those in which they are produced with those into which they are imported, it is obvious that, considered merely with reference to the exchange, it must differ considerably. Gold and silver, like coal, tin, &c. must always be really cheaper in countries possessed of extraordinarily productive mines, than in those possessed of mines of a secondary degree of fertility, or in which they are entirely imported from abroad. And the exchange between such places can only be at true *par* when adequate allowance has been made for this difference of value. Thus, if, because of the expence

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* Supposing every country to be in possession of its proper supply of bullion, the exchange may be said to be *nominally* affected by the amount of the difference between the market and mint price of bullion, and to be *really* affected by any deviation from *par* exceeding or falling short of that difference.

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of carriage, the value of bullion in Great Britain is 5 *per cent.* greater than in Rio Janeiro, 100 ounces of pure gold in Rio Janeiro would not be worth 100 ounces of pure gold in London, but 5 *per cent.* less; and the exchange would be at true *par* when bills for 105 ounces of standard bullion payable in Rio Janeiro, sold in London for 100 ounces.

The differences in the value of the precious metals in different countries, have not been confined to those which depend on their respective distances from the mines, or on their different progress in the arts. The opinion formerly so very prevalent, that gold and silver alone constituted real wealth, induced almost every commercial nation to fetter and restrict their exportation, and to adopt a variety of measures intended to facilitate their importation. But these regulations, even when most rigorously enforced, have been singularly ineffectual; the great value and small bulk of the precious metals, rendering it not only extremely advantageous, but also comparatively easy to smuggle them abroad, whenever their relative value declined.

"When," says Dr Smith, "the quantity of gold and silver imported into any country exceeds the effectual demand, no vigilance of government can prevent their exportation. All the sanguinary laws of Spain and Portugal are not able to keep their gold and silver at home. The continual importations from Peru and Brazil exceed the effectual demand of those countries, and sink the price of these metals *below* their price in the neighbouring countries. If, on the contrary, in any particular country their quantity fell short of the effectual demand, so as to raise their price *above* that of the neighbouring countries, the government would have no occasion to take any pains to import them. If it were even to take pains to prevent their importation, it would not be able to effect it. Those metals, when the Spartans had got wherewithal to purchase them, broke through all the barriers which the laws of Lycurgus opposed to their entrance into Lacedemon. All the sanguinary laws of the customs are not able to prevent the importation of teas of the Dutch and Gottenburgh East India Companies, because somewhat cheaper than those of the British Company. A pound of tea, however, is about an hundred times the bulk of one of the highest prices, 16s., that is commonly paid for it in silver, and more than two thousand times the bulk of the same price in gold, and is consequently just so many times more difficult to smuggle." (*Wealth of Nations*, Vol. II. p. 149.)

But, however ineffectual as a means of entirely preventing the egress of the precious metals, the restrictions on their exportation have nevertheless contributed to occasion some slight variations in their value in different countries. The risk incurred by the clandestine exporters of bullion from Spain is supposed to be equivalent to about 3 *per cent.*; or, which is the same thing, it is supposed, that the restrictions maintain such an excess of gold and silver in that country as to sink their value 3 *per cent.* below their value in those countries in which the trade in bullion is unrestricted. In calculating the true *par* of exchange between Spain and other countries, this circumstance must be taken into account. For, however much the value of bullion in one country may be reduced below its value in those with which it maintains an intercourse, the nominal exchange must necessarily be unfavourable to that extent. *

It results as a consequence of these principles, that whatever occasions a rise or fall in the relative value of the precious metals, in a particular country, must proportionably affect its nominal exchange with other countries. If more coin, or paper convertible into coin or bullion, circulated in Great Britain, compared with the business it had to perform than what circulated in other countries, its relative value would in consequence be diminished. Foreign bills would sell for a premium, the amount of which would be precisely equal to the excess of the value of the precious metals in the foreign market, caused by their redundancy in the home market; and, on the other hand, in the event of the currency becoming relatively deficient, its value would be proportionably increased;—bills drawn on foreign countries would sell at a discount, the amount of which would measure the excess of the relative value of the currency of this over that of other countries.

Manner of estimating the quantity of Bullion contained in the Coins of different Countries.

II. In estimating the comparative quantity of bullion contained in the currencies of different countries, a particular coin of one country, such as the British pound Sterling, is selected as an *integer* or standard of comparison, and the proportion between it and the coins of other countries of their *mint standard weight and fineness* is ascertained by experiment. A *par* of exchange is thus established; or rather it is ascertained, that a certain amount of the standard currency of any particular country contains precisely as much gold or silver of the same fineness, as is contained in the coin or integer with which it had been compared. This relation or *par*, as it is technically termed, is considered invariable; and allowance is made for the subsequent variations in the comparative quantity and purity of the bullion contained in the currencies of countries trading together, by rating the exchange at so much above or below *par*. In mercantile language, that country, by a comparison with one or other of whose coins the *par* of exchange has been established, is said to give the *certain* for the *uncertain*, and conversely. Thus, in the exchange between London and Paris, London and Hamburgh, &c., London gives the *certain*, or the pound Sterling, for an *uncertain* or variable number of francs, schillings, &c. Hence, the higher the exchange between any two countries, the more it is in favour of that which gives the *certain*, and the lower the more is it in favour of that which gives the *uncertain*.

Effects of variations in the value of metallic Currency on the Exchange.

On the supposition, which is very near the truth, that 25 francs contain the same quantity of standard bullion as a pound Sterling (25 francs, 20 centimes, is the exact par); and supposing also, that

* All restraints on the exportation of the precious metals were abolished in Great Britain in 1819. Their effect, for many years previous, could not be estimated at above $\frac{1}{4}$ *per cent.*

Nominal Exchange.

the relative value of bullion is the same in both countries, the exchange between London and Paris will be at *par*, when a bill drawn by a merchant in the one, on his correspondent in the other, sells at that rate; that is, when a bill of exchange for 2500 or 25,000 francs payable in Paris, sells in London for L. 100 or L. 1000, and *vice versa*. It is but seldom, however, that the coins of any country correspond exactly with the mint standard; unless, when newly issued, they are all either more or less worn; and whenever this is the case, an allowance corresponding to the difference between the actual value of the coins and their mint value, must be made in estimating "*the sum of the existing currency of either of two countries which contains precisely the same quantity of bullion as is contained in a given sum of the other.*" Thus, if the one pound Sterling was so worn, clipped, rubbed, &c. as not to contain so much bullion as 25 francs, but 10 *per cent.* less, the exchange between London and Paris would be at real *par*, when it was nominally 10 *per cent.* against London;* and if, on the other hand, the pound Sterling was equal to its mint standard, while the franc was 10 *per cent.* less, the exchange between London and Paris would be at real *par*, when it was nominally 10 *per cent.* against Paris, and in favour of London. If the currency of both countries was *equally* reduced below the standard of their respective mints, then it is obvious there would be no variation in the real *par*. But whenever the currency of countries trading together is depreciated in an *unequal* degree, the exchange will be nominally in favour of that country whose currency is least depreciated, and nominally against that whose currency is most depreciated.

It is almost unnecessary to refer to the history of the exchange to show the practical operation of this principle; and we shall content ourselves with selecting the following, from an infinite number of equally conclusive instances.

In a pamphlet printed in 1604, but written in 1564, it is mentioned, that when Henry VIII. degraded the several species of coin then current, there began to be "*some disorder*" in the price of all wares and commodities; which Edward VI., thinking to remedy by diminishing still farther the quantity of pure silver contained in each coin; the consequence was, that *the English pound Sterling, which heretofore exchanged abroad for 26 Flemish schillings, became worth no more than 13 Flemish schillings;* the price of English commodities being at the same time proportionably increased.—(Mr John Smith's *Memoirs of Wool*, Vol. I. p. 105. 8vo ed.)

Previous to the great recoinage in the reign of William III., silver being at that time the metal in which payments were legally made, the *nominal* exchange between England and Holland, calculated according to the standard of their respective mints, was 25 *per cent.* against England; but, inasmuch as the real value of the English coin was, at that epoch, depreciated more than 25 *per cent.* below its mint value, the real exchange may notwithstanding have been in favour of England. The circumstance of the *nominal* exchange having become favourable to this country as soon as the new coin had been issued, renders this conjecture extremely probable.—(*Wealth of Nations*, Vol. II. p. 215.)

Before the reformation of our gold coin in 1774, the guinea contained so much less than its standard weight, that it was degraded 2 or 3 *per cent* when compared with the French coin at the same period; and the exchange between England and France was then computed to be 2 or 3 *per cent. against* this country. Upon the reformation of the gold coin, the exchange rose to *par*. The Turkish government, in the course of the last forty years, has made three great alterations in the value of its coin. Before these frauds were committed, the Turkish *piastre* contained nearly as much silver as the English *half-crown;* and hence, in exchange, the *par* was estimated at *eight* piastres to the pound Sterling. The consequence of these repeated adulterations has been, the reduction of the silver in the piastre to one half, and a fall in the exchange of 100 *per cent.* bills on London having been bought in Turkey, in 1803, at the rate of 16 piastres for every pound Sterling.† Now, although it is not absolutely certain that these fluctuations in the *nominal* exchange were entirely owing to the alterations in the value of the coin, because the real exchange, or that which depends on the abundance or scarcity of bills in the market compared with the demand, might not be constant; yet the exact correspondence of the fall of exchange with the acknowledged degradation of the coin, renders it more than probable that it proceeded almost entirely from that degradation.‡

Effects of variations in the relative value of Gold and Silver on the Exchange.

When one country uses gold as the standard of its currency, and another silver, the *par* of exchange between these countries is affected by every variation in the relative value of these metals. When gold rises in value comparatively to silver, the exchange becomes nominally favourable to that country which has the gold standard, and *vice versa*. And hence, in making a correct estimate of the state of the exchange between those countries which use different standards, it is always necessary to advert to the comparative value of the metals which are assumed as such.

"For example," to use the words of Mr Mushet,

* It is necessary to observe, that it is here supposed that the clipped or degraded money exists in such a degree of abundance, as only to pass current at its bullion value. If the quantity of clipped money were *sufficiently limited*, it might, notwithstanding the diminution of weight, pass current at its mint value; and then the *par* would have to be estimated, not by its relative weight to foreign money, but by the mint price of bullion. This is a principle which must be constantly kept in view.

† Il est impossible d'indiquer exactement le *pair* des monnoies Turques. On voit des pieces du même nom, et frappées la même année, qui different de 100 *pour cent.* dans leur valeur intrinseque. (Storch, *Cours D'Economie Politique*, Tom. VI. p. 336.)

‡ *Observations on the Principles which regulate the Course of Exchange, by* William Blake, Esq. p. 41.

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"If 34 schillings 11 grotes and $\frac{1}{4}$ of Hamburgh currency be equal in value to a pound Sterling, or $\frac{20}{21}$ of a guinea, when silver is at 5s. 2d. *per* oz. they can no longer be so when silver falls to 5s. 1d. or 5s. an oz. or when it rises to 5s. 3d. or 5s. 4d.; because a pound Sterling in gold being then worth more or less silver, is also worth more or less Hamburgh currency.

"To find the real *par*, therefore, we must ascertain what was the relative value of gold and silver when the *par* was fixed at 34s. 11$\frac{1}{4}$g. Hamburgh currency, and what is their relative value at the time we wish to calculate it.

"For example, if the price of standard gold was L. 3, 17s. 10$\frac{1}{2}$d. *per* oz. and silver 5s. 2d. an ounce of gold would then be worth 15.07 ounces of silver, and twenty of our standard shillings would then contain as much pure silver as 34s. 11 grotes, and $\frac{1}{4}$. Hamburgh currency. But if the ounce of gold were L. 3, 17s. 10$\frac{1}{2}$d. and silver 5s. (which it was on 2d January 1798), the ounce of gold would then be worth 15.57 ounces of silver. If L. 1 Sterling at *par*, therefore, be worth 15.07 ounces of silver, then at 15.57 it would be at 3 *per cent.* premium; and 3 *per cent.* premium on 34s. 11$\frac{1}{4}$. is 1 schilling 1 grote and $\frac{9}{10}$, so that the *par* when gold is to silver as 15.57 to 1, will be 36 schillings 1 grote and $\frac{1}{10}$. The above calculation will be more easily made by stating as "15.07 : 34-11$\frac{1}{4}$ :: 15.57 : 36-1$\frac{1}{10}$." *

In the Table of the Course of Exchange, &c. between London and Hamburgh from 1760 to 1819, annexed to this article, the fluctuations in the comparative value of gold and silver have been attended to throughout, and the true *par* calculated accordingly.

Effect of Seignorage on the Exchange.

As it is by their intrinsic worth as bullion that the relative value of the coins of particular countries is estimated in exchange, two coins of equal weight and purity are reckoned equivalent to each other, although the one should have been coined at the expence of the state, and the other charged with a *seignorage*, or duty on its coinage. Coins on which a *seignorage* is charged may, if not issued in excess, pass current in the country where they are coined, at a value so much higher than their value in bullion; but they will not pass at any higher value in other countries. †

Effect of variations in the value of paper currency on the Exchange.

But the principal source of fluctuations in the nominal price of bills of exchange is to be found in the varying value of the *paper* currency of commercial countries. The disorders which universally arose in rude ages from the diminution of the quantity of standard bullion contained in the coins of different countries, are now reproduced in another form, and often to a still more ruinous extent, in the depreciation of their paper currency.

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The impossibility of retaining a comparatively large quantity either of coin or bullion, or of paper convertible into coin, in a particular country, previously to the Restriction Act of 1797, effectually limited the issues of the Bank of England, and sustained the value of British currency on a par with the currency of other countries. When the Bank issued less paper than was necessary for this purpose, the value of the currency being relatively great, it became profitable to import bullion, and to send it to the mint to be coined: And, on the other hand, when the Bank issued too much paper, and thereby depressed its value relatively to gold, it became profitable to demand payment of its notes in specie, and, thereafter, to export this specie either in the shape of coin or as bullion. In this way the Bank was compelled to limit its issues when excessive, and, consequently, to put a stop to the demand for gold, by rendering its paper of equal value.

Had the Bank of England, subsequently to the restriction, continued to issue only such quantities of paper as might have been required to sustain its value on a par with the value of gold, the act of 1797 would not have occasioned any real difference in our monetary system. But after the Bank had been released from all obligation to pay its notes, it was not to be expected that it should be very careful about limiting their number. The restriction *enabled* the Directors to exchange bits of engraved paper worth perhaps not more than 5s. a quire, for as many, or the value of as many hundreds of thousands of pounds. And in such circumstances our only wonder is, not that paper money became depreciated, but that its value was not more degraded, —that a still greater quantity of bank-notes were not forced into circulation.

A country with an inconvertible paper currency, of which an undue proportion has been issued, is in a similar situation to what a country would be in if it were possessed of a relatively redundant gold and silver currency, and if the laws prohibiting the melting or exportation of the coin could be carried into full effect. Such a currency is necessarily confined to the country where it is issued; it cannot, when too abundant, diffuse itself generally amongst others. The level of circulation is destroyed; and the value of the currency becoming less than the value of the currency of other countries, the nominal exchange is rendered proportionably unfavourable.

Supposing that nothing but silver coin of the standard weight and purity (25 francs of which would exchange for a pound Sterling of the British

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* *An Inquiry into the Effects produced on the National Currency by the Bank Restriction Bill, &c. by* Robert Mushet, Esq. second edit. p. 94.

† Previous to 1817, no seignorage had for a very long period been deducted from either the gold or silver coins of Great Britain; but in the great recoinage of that year, the value of silver was raised from 5s. 2d. to 5s. 6d. an ounce, or nearly in the proportion of 6$\frac{1}{2}$ *per cent.* The gold coins, however, are still coined free of expence, and no variation has been made in their standard. The British mint proportion of silver to gold is now as 14$\frac{287}{1000}$ to 1; that is, one ounce of standard gold bullion is rendered exchangeable for 14$\frac{287}{1000}$ ounces of standard silver. In France, the mint proportion of the two metals is as 15$\frac{1}{2}$ to 1; a seignorage being exacted of nearly $\frac{1}{5}$ *per cent.* on gold, and 1$\frac{1}{2}$ *per cent.* on silver.

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mint standard) circulates at Paris, and that the circulating medium of London is composed entirely of paper only worth half its nominal value, or which is depreciated 100 *per cent.*,—in that case the exchange between London and Paris would be at *real* par, when it was nominally *cent. per cent.* against London and in favour of Paris. Double the amount of this depreciated London currency would be required to purchase a bill of exchange on Paris where the currency retained its value, while half the former amount of Parisian currency would now suffice to purchase a bill payable in London. The effects of such a depreciation would be precisely the same with those which would follow from a similar reduction in the value of metallic money. While paper money, depreciated 100 *per cent.*, constituted our legal currency, a pound note, instead of being worth 25 francs, would only be worth $12\frac{1}{2}$; and the nominal or numerical value of the bills of exchange negociated between this country and France would be regulated accordingly:—that is, a bill of exchange for L. 100 or L. 1000 payable in London, would sell in Paris for 1250 or 12,500 francs, and conversely. If, while the currency of London remained steady at 100 *per cent.* below its mint value, Parisian currency should, either from the coins becoming deficient in weight, or because of an inordinate issue of paper money, become also depreciated, the *nominal* exchange would be rendered proportionably less unfavourable to London. On the hypothesis that the currency of Paris is depreciated 50 and that of London 100 *per cent.*, the *nominal* exchange would be 50 *per cent.* against the latter, and so on. Thus it appears, that the *nominal* exchange between any two or more places will always be adjusted in proportion to the relative value of their currencies: being most favourable to that country whose currency approaches nearest to its mint standard, and most unfavourable to that whose currency is most degraded.

Exchange between Great Britain and Ireland subsequent to 1797.

The state of the exchange between Great Britain and Ireland subsequently to the restriction on cash payments in 1797, furnishes a striking proof of the effects which inordinate issues of paper have in depressing the exchange.

The nominal value of the Irish shilling having been raised from 12d. to 13d., or, which is the same thing, L. 108, 6s. 8d. of Irish money having been rendered only equal to L. 100 of British money, it follows, that when the exchange between Great Britain and Ireland is at $8\frac{1}{3}$ *per cent.* against the latter, it is said to be at *par*. In the *eight* years previous to 1797, when the paper currency both of England and Ireland was convertible into gold, the exchange between London and Dublin fluctuated from $7\frac{1}{2}$ to 9 *per cent.*, that is, from $\frac{5}{6}$ *per cent.* in favour of Dublin, to $\frac{2}{3}$ *per cent.* against it. In September 1797, it was so low as 6 *per cent.*, or $2\frac{1}{3}$ *per cent.* in favour of Dublin. The amount of the notes of the Bank of Ireland in circulation in January 1797 was only L. 621,917; but in April 1801, they had increased to L. 2,286,471, and the exchange was then at 14 *per cent.*, or $5\frac{2}{3}$ *per cent. against* Dublin. In 1803, the Bank of Ireland notes in circulation averaged L. 2,707,956, and in October of that year the exchange rose to 17 *per cent.*, that is, to $8\frac{2}{3}$ *per cent.* against Dublin!

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The fact of the exchange between London and Dublin having fluctuated so very little from real par for eight years previous to the restriction, shows that the circulating medium of Great Britain and Ireland had then been adjusted very nearly according to the relative wants of the two countries. But, in these circumstances, it was evidently impossible, supposing the value of British currency to have remained stationary, that the quantity of Irish bank paper could be nearly *quintupled* in the short space of six years, without rendering the currency of Ireland comparatively redundant, and sinking its value below that of England. Had the Bank of England increased its notes nearly in the same ratio as the Bank of Ireland, then, as the currency of both countries would have been *equally depreciated*, the exchange between London and Dublin would have continued at *par*. But while the notes of the Bank of Ireland were increased from L. 621,917 to L. 2,707,956, or in the proportion of 1 to 4.3, those of the Bank of England were only increased from L. 9,181,843 (their number on 7th January 1797), to L. 16,505,272, or in the proportion of 1 to 1.8. If the Bank of England had not made this addition to its issues, the exchange would obviously have been still more unfavourable to Dublin.

In the debates on the Bullion Report, it was contended that the increase of Bank of Ireland paper could not be the cause of the exchange becoming unfavourable to Dublin, inasmuch as it had again become favourable, after the issues of the Bank of Ireland had been still further increased. Nothing, however, can be more inconclusive than such reasoning. Before it can be brought to have the least incidence on the case in question, it must be shown that the value of the currency of Great Britain had, in the interim, remained stationary, or that it had not been depreciated to the same extent as that of Ireland. Unless this can be established, the circumstance of the exchange between London and Dublin coming to par, while as many notes of the Bank of Ireland circulated as in the period of its greatest depression, will not authorize us to conclude that the increase of Irish Bank paper previously to 1804 had not been the cause of the then fall in the exchange. For, it is obvious that the depreciation of Irish Bank paper might be going on subsequently to 1804: and yet, on the supposition that the depreciation of English Bank paper had gone on still more rapidly, the exchange must necessarily have become more favourable to Dublin. This is just supposing the circumstances which took place in the first six years of the restriction, to be reversed in the second six. Let us examine how the fact stands.

We have just seen that, in 1803, when the exchange was nominally 10 *per cent.* against Dublin, the issues of the Bank of England amounted to L.16,505,272, and those of the Bank of Ireland to L.2,707,956. And, by referring to the account of the issues of the Bank of Ireland from 1797 to 1819, annexed to this article, it will be seen that, in 1805, 1806, 1807, and 1808, they were rather *diminished;* and that, in 1810, they only amounted to L.3,251,750, being an increase of not more than L.543,794, in the space of seven years, or at the rate of $2\frac{6}{7}$ *per*

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cent. per annum; but, in the same period (from 1803 to 1810), the issues of the Bank of England had increased from L.16,505,272 to L.22,541,523, or at the rate of 5 *per cent. per annum*. But this is not all: According to Mr Wakefield (*Account of Ireland*, Vol. II. 171), who has left no subject untouched which could throw light on the state of Ireland, there were *fifty* registered bankers in that country in 1804, and only *thirty-three* in 1810, of which fourteen were new houses, thirty-one of the old establishments having disappeared; "and I believe," says Mr Wakefield, "*for the most part failed*." This extraordinary diminution of the country paper of Ireland, for the reduction of the issues was at least proportionate to the reduction in the number of banks, must have greatly raised its value, and would have counteracted a very great increase in the issues of the National Bank. Now the very reverse of all this took place in Britain. In 1800, there were 386 country banks in this country; and, in 1810, this number, instead of being diminished, as in Ireland, had increased to 721, having at least twice the number of notes in circulation in the latter as in the former period!

It appears, therefore, that when, in the period between 1797 and 1804, the quantity of paper in circulation in Ireland was increased, and consequently its value depressed, faster than in England, the exchange between London and Dublin became proportionably unfavourable to the latter; and, on the other hand, it appears that when, in the six years subsequent to 1804, the paper currency of England was increased more rapidly than the paper currency of Ireland, its relative value was diminished, and the *nominal* exchange became more favourable to Dublin.

But, however conclusive this must appear, there is still stronger and more decisive evidence to show that the unfavourable exchange of Dublin upon London in 1802, 1803, 1804, &c. was entirely owing to the comparative redundancy, or depreciation, of Irish Bank paper. The linen manufacturers, weavers, &c. and the majority of the other inhabitants of a few counties in the north of Ireland, being, at the period of the restriction, strongly disaffected towards government, they almost unanimously refused to receive bank notes, either in payment of commodities or as wages. The landlords, having also stipulated for the payment of their rents in specie, the consequence was, that a gold currency was maintained in the north of Ireland long after it had been entirely banished from the southern part of the island. If, therefore, the depressed state of the exchange between London and Dublin had been occasioned, as was contended by the advocates of the restriction, either by an unfavourable balance of trade between Ireland and Great Britain, or by remittances from the former on account of absentee landlords, &c. it would have been equally depressed between London and the commercial towns in the northern countries. But, so far from this being the case, in December 1803, when the exchange of Dublin on London was at $16\frac{1}{4}$ *per cent.*, that of Belfast on London was at $5\frac{1}{4}$. Or, in other words, at the same time that the exchange between Dublin and London was about 8 *per cent. against* Ireland, the exchange between Belfast, *which had a gold currency*, and London, was about 3 *per cent.* in its *favour*. Nor is this all. There was not only a difference of 11 *per cent.* in the rate of exchange between Dublin and London, and Belfast and London, but the *inland* exchange between Dublin and Belfast was, at the same time, about 10 *per cent.* in favour of the latter; that is, bills drawn in Dublin, and payable in the gold currency of Belfast, brought a premium of 10 *per cent.* while bills drawn in Belfast, and made payable in the paper currency of Dublin, sold at 10 *per cent.* discount. *

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It is unnecessary, we conceive, to refer particularly to the history of the French *assignats*, or of the paper currency of the other continental powers, and of the United States, to corroborate what has been here advanced. Such of our readers as wish for more detailed information, may have recourse to the sixth volume of the *Cours D'Economie Politique*, of M. Storch, where they will find a very able, perspicuous, and instructive account of the effects produced by the issues of paper on the price of bullion and the exchange in almost every country in Europe. They are, in every case, precisely similar to those we have just stated.

It now only remains to determine the effects of fluctuations in the *nominal* exchange on the export and import trade of the country.

Inquiry into the effects of fluctuations in the nominal Exchange on Export and Import Trade.

When the exchange is at *par*, the operations of the merchant are regulated entirely by the difference between foreign prices and home prices. He imports those commodities which can be sold at home for so much more than their price abroad as will, after indemnifying him for the expence of freight, insurance, &c. yield an adequate remuneration for his trouble, and for the capital employed in importing them; and he exports those whose price abroad is so much greater than at home as will suffice to cover all expences, and to afford a similar profit. But when, because of a fall in the value of its currency, the *nominal* exchange becomes unfavourable to a particular country, the premium which its merchants receive on the sale of foreign bills, has been supposed capable of enabling them to export with profit in cases where the difference between the price of the exported commodities at home and abroad might not be such as would have permitted their exportation had the exchange been at *par*. Thus, if the *nominal* exchange was 20 *per cent.* against this country, a merchant who had consigned goods to his agent

* Farther information on this interesting subject may be obtained from the very able *Report of the Committee of the House of Commons*, appointed in 1804 to inquire into the state of the circulating paper in Ireland, its specie, &c. and the state of the exchange between it and Great Britain; in Mr Parnell's excellent pamphlet on the same subject; and in the pamphlets of Lord King, Mr Huskisson, &c.

abroad, would receive a premium of 20 *per cent.* on the sale of the bill; and if we suppose freight, insurance, mercantile profit, &c. to amount to 12 or 15 *per cent.*, it would at first sight appear as if our merchants might, in such circumstances, export commodities although their price at home should be 5 or 8 *per cent.* higher than in other countries. If, on the other hand, the *nominal* exchange was in our favour, or if bills *on* this country sold at a premium, it would appear as if foreigners would then be enabled to consign goods to our merchants, or our merchants to order goods from abroad, when the difference of real prices was not such as would of itself have led to an importation.

But a very little consideration will convince us that fluctuations in the *nominal* exchange can have no such effect. The same fall in the value of the currency which renders the exchange unfavourable, and causes foreign bills to sell at a premium, must *equally increase* the price of all commodities. And hence whatever might be the amount of the premium which the exporter gained by the sale of the bill drawn on his correspondent abroad, it would do no more than indemnify him for the enhanced price of the goods exported. Mercantile operations are in such cases, conducted precisely as they would be if the exchange was really at *par;* that is, by a comparison of the real prices of commodities at home and abroad, meaning, by real prices, the prices at which they would be sold, provided there was no depreciation of the currency. If those prices are such as to admit of exportation or importation with a profit, the circumstance of the nominal exchange being favourable or unfavourable will make no difference whatever on the transaction.

"Suppose," says Mr Blake, who has very successfully illustrated this part of the doctrine of exchange, "the currencies of Hamburgh and London being in their due proportions, and therefore the *nominal* exchange at *par*, that sugar, which, from its abundance in London, sold at L. 50 *per* hogshead, from its scarcity at Hamburgh, would sell at L. 100. The merchant in this case would immediately export. Upon the sale of his sugar, he would draw a bill upon his correspondent abroad for L.100, which he could at once convert into cash, by selling it in the bill market at home, deriving from this transaction a profit of L. 50, under deduction of the expences of freight, insurance, commission, &c. Now, suppose no alteration in the scarcity or abundance of sugar in London and Hamburgh, and that the same transaction were to take place, after the currency in England had been so much increased, that the prices were doubled, and, consequently, the *nominal* exchange 100 *per cent.* in favour of Hamburgh, the hogshead of sugar would then cost L. 100, leaving apparently no profit whatever to the exporter. He would, however, as before, draw his bill on his correspondent for L. 100; and, as foreign bills would bear a premium of 100 *per cent.*, he would sell this bill in the English market for L. 200, and thus derive a profit from the transaction of L. 100 depreciated pounds, or L. 50 estimated in undepreciated currency, deducting, as in the former instance, the expence of freight, insurance, commission, &c.

"The case would be precisely similar, *mutatis mutandis*, with the importing merchant. The unfavourable *nominal* exchange would appear to occasion a loss, amounting to the premium on the foreign bill, which he must give in order to pay his correspondent abroad. But if the difference of *real* prices in the home and foreign markets were such, as to admit of a profit upon the importation of produce, the merchant would continue to import, notwithstanding the premium; for that would be repaid to him in the advanced *nominal* price at which the imported produce would be sold in the home market.

"Suppose, for instance, the currencies of Hamburgh and London being in their due proportions, and, therefore, the *nominal* exchange at *par*, that linen, which can be bought at Hamburgh for L. 50, will sell here at L. 100. The importer immediately orders his correspondent abroad to send the linen, for the payment of which he purchases at L. 50 a foreign bill in the English market, and on the sale of the consignment for L. 100 he will derive a profit, amounting to the difference between L. 50 and the expence attending the import.

"Now, suppose the same transaction to take place, without any alteration in the scarcity or abundance of linen at Hamburgh and London, but that the currency of England has been so augmented, as to be depreciated to half its value, the *nominal* exchange will then be 100 *per cent.* against England, and the importer will not be able to purchase a L.50 foreign bill for less than L. 100. But as the prices of commodities here will have risen in the same proportion as the money has been depreciated, he will sell his linen to the English consumer for L. 200, and will, as before, derive a profit amounting to the difference between L. 100 depreciated, or L. 50 estimated in undepreciated money, and the expences attending the import.

"The same instances might be put in the case of a favourable exchange; and it would be seen in the same manner, that *nominal* prices and the *nominal* exchange being alike dependant on the depreciation of currency, whatever apparent advantage might be derived from the former, would be counterbalanced by a loss on the latter, and *vice versa*."—(*Observations, &c.* p. 48.)

It appears, therefore, that fluctuations in the *nominal* exchange have no effect on export or import trade. A fall in the exchange obliges the country, to which it is unfavourable, to expend a larger *nominal* sum in discharging a foreign debt than would otherwise be necessary; but it does not oblige it to expend a greater *real* value. The depression of the *nominal* exchange can neither exceed nor fall short of the comparative depreciation of the currency. If the depreciation of British currency amounted to 100 or 1000 *per cent.*, the *nominal* exchange would be 100 or 1000 *per cent.* against us; and we should be compelled in all our transactions with foreigners to give them L. 2, or L. 10, for what might otherwise have been procured for L. 1. But as neither L. 2, nor L. 10 of paper, depreciated to the extent of 100 or 1000 *per cent.*, would be more valuable than one pound of undepreciated paper, payment of a foreign

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debt might, it is evident, be just as easily made in the one currency as in the other; and mercantile transactions would, in such circumstances, be conducted exactly as they would have been had the currency been undepreciated, and the *nominal* exchange at *par*.

It is necessary, however, before dismissing this part of our subject, particularly to examine the effects of fluctuations in the *nominal* exchange on the importation and exportation of *bullion*. In certain cases they form an exception to the general principle we have been endeavouring to elucidate.

Effects of fluctuations in the Nominal Exchange on the trade in Bullion.

If the *nominal* exchange were to become unfavourable to a country which had entirely discarded the precious metals from its circulation, Mr Blake's opinion that the fall of the exchange has no effect on the export and import of bullion, more than of any other commodity, would be perfectly well founded. In this case the price of all sorts of commodities, and of bullion among the rest, would be increased precisely according to the depreciation of the currency; and the merchants who should, in such circumstances, attempt to export bullion would find that its increased price in the home market would be exactly equivalent to whatever premium they might gain by the sale of the bills drawn on their agents abroad for its price. But when the *nominal* exchange becomes unfavourable to a country whose currency either consists entirely of the precious metals, or partly of them and partly of paper, a different effect would be produced.

In this case the depreciation would necessarily add to the stock of bullion in the country. For, as soon as the currency had been depreciated to such an extent, as to render the excess of the market above the mint price of bullion sufficient to cover the very trifling expences attending the melting of the coin, and to afford some little remuneration for the trouble of the melters, they would immediately set about converting it into bullion. If, indeed, it were possible to realize a greater profit by the exportation than by the fusion of the coins, they would not be converted into bullion, and, of course, its real price would continue stationary. But this is very seldom the case. The operation of melting is so extremely simple, and requires so very little apparatus, that it may, in almost every instance, be carried on at a much less expence than would be necessary to export the coins. The cost attending the conveyance of gold to France varies, in a season of peace, from 1 to 2 *per cent.*; while a profit of $\frac{1}{4}$ or $\frac{1}{2}$ *per cent.* is sufficient to indemnify the melters of guineas or sovereigns. It is obvious, therefore, that of the two modes of restoring the value of the currency when it becomes depreciated, or relatively redundant, that of fusion will be generally resorted to in preference to exportation. Should the redundancy of the currency be inconsiderable, all the addition which the operations of the melters could make to the supply of bullion, would most probably be insufficient to occasion any perceptible fall in its *real* price. But, in every case in which the redundancy or depreciation of the currency is considerable, the fusion of the coined money never fails to increase the quantity of bullion beyond the effectual demand, and, consequently, to occasion a fall in its *real* price, and to render it a profitable article of export. The demand for bullion, though it must always vary with the varying wealth and riches of the community, fluctuates very little in periods of limited duration; and no considerable addition can ever be made to the stock on hand in a particular country, without sinking its value and causing its egress.

Mr Blake contends, that this exportation of bullion is the effect of the melting of the coin, and not the cause of it; and in so far he is certainly right. But we do not see how this in the least strengthens his opinion, that fluctuations in the *nominal* exchange, even in those cases in which the currency consists either wholly or partially of the precious metals, have no influence on the export and import of bullion. Surely it is impossible to deny, that the fusion of the coin, of which Mr Blake admits the exportation of bullion is a necessary consequence, is occasioned by a redundancy of the currency, or by the same cause which occasions an unfavourable *nominal* exchange.

Bullion, therefore, forms an exception, and it is the only one, to the general principle that a fall in the value of the currency, or an unfavourable *nominal* exchange, has no effect on importation or exportation. But this exception does not take place, except in those cases in which the currency consists either in *whole* or in *part* of the precious metals. When the currency consists *entirely* of paper, or of any commodity other than gold or silver, its depreciation can have no influence whatever on the importation of bullion.

Section II.—*Real Exchange.*

Real Exchange.

Having thus endeavoured to trace the effects which variations in the value of the currencies of countries maintaining an intercourse together have on the exchange; we shall now proceed to consider how far it is influenced *by fluctuations in the supply and demand for bills*. To facilitate this inquiry, we shall exclude all consideration of changes in the value of money; or, which is the same thing, we shall suppose the currencies of the different countries having an intercourse together to be all fixed at their mint standards, and that each has its proper supply of bullion.

When two nations trade together, and each purchases from the other commodities of precisely the same value, their debts and credits will be equal, and, of course, the real exchange will be at *par*. The *bills* drawn by the one will be exactly equivalent to those drawn by the other, and their respective claims will be adjusted without requiring the transfer of bullion, or other valuable produce. But it very rarely happens that the debts reciprocally due by any two countries are equal. There is almost always a balance owing on one side or other; and this balance must affect the exchange. If the debts due by London to Paris exceeded those due by Paris to London, the competition in the London market for bills on Paris would, because of the comparatively large sum which our merchants had to remit to France, be greater than the competition in Paris for bills on London; and, consequently, the *real* ex-

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change would be n favour of Paris and against London.

Limit to fluctuations in the Real Exchange.

The expence of the transfer of bullion from one country to another, constitutes the limit within which the rise and fall of the *real* exchange between them must be confined. In this respect, as in most others, transactions between foreign countries are regulated by the very same principles which regulate those between different parts of the same country. We have already shown how the fluctuations, in the *real* exchange between London and Glasgow, could never exceed the expence of transmitting money between those cities. The same principle holds universally. Whatever may be the expence of transmitting bullion, or the money of the commercial world, between London and Paris, Hamburgh, New York, &c., it is impossible that the *real* exchange of the one on the other should, for any considerable period, be depressed to a greater extent. For no merchant will ever pay a greater premium for a bill to discharge a debt abroad, than what would suffice to cover the expence of transmitting bullion to his creditor.

Hence it appears, that whatever has a tendency to obstruct or fetter the intercourse between different countries, must also have a tendency to widen the limits within which fluctuations in the *real* exchange may extend. It is this principle which enables us to account for its varying so much more in time of war than in time of peace. The amount of the bills drawn on a country engaged in hostilities is, from various causes which we shall afterwards notice, liable to be suddenly increased; though it is certain, that whatever may be the amount of the bills thus thrown into the market, the depression of the exchange cannot, for any length of time, exceed the expence of conveying bullion from the debtor to the creditor country. But during war this expence is increased; the charges on account of freight, insurance, &c., being then necessarily augmented. It appears from the evidence annexed to the *Report of the Bullion Committee*, that the expence of conveying gold from London to Hamburgh, which, previously to the war, only amounted to 2 or 2½ *per cent.*, had, in the latter part of 1809, increased to about 7 *per cent.*; showing, that the limits within which fluctuations in the real exchange were confined in 1809, were about *three* times as great as those within which they were confined in 1793.

This principle also enables us to account for the greater steadiness of the real exchange between countries in the immediate vicinity of each other. The expence of transmitting a given quantity of bullion from London to Dublin or Paris, is much less than the expence of transmitting the same quantity from London to New York or Petersburgh. And, as fluctuations in the *real* exchange can only be limited by the cost of transmitting bullion, they may consequently extend much farther between distant places, than between those that are contiguous.

Inquiry into the circumstances which give rise to a favourable or an unfavourable balance of payments.

It will now be proper to investigate the circumstances which gave rise to a favourable or an unfavourable balance of payments, and to appreciate their effects on the real exchange, and on the trade of the country in general. As this is one of the most important inquiries in the whole science of political economy, it will require to be discussed at some length.

A very great, if not the principal, source of the errors into which practical merchants and the majority of writers on the subject of exchange have been betrayed, appears to have originated in their confounding together the sum which imported commodities are worth in the home market, with the sum which they cost in the foreign market. It is obviously, however, by the amount of the latter only, that the balance of payments, and consequently the *real* exchange, is influenced. A cargo of iron, for example, which had been bought in Gottenburgh for L. 1000, might be worth L. 1400 or L. 1500 when imported into England; but the foreign merchant would not be entitled to draw a bill on London for more than its original cost or L. 1000. It is clear, therefore, even on the slightest consideration, that the circumstance of the value of the imports exceeding the value of the exports, does not authorize the conclusion that the balance of payments is unfavourable. A favourable or an unfavourable balance depends entirely on the fact whether the sum due *to* foreigners for commodities imported from abroad, is less or more than the sum due *by* them for the commodities they have purchased; but it has nothing to do with the prices which may eventually be obtained for the imported or exported commodities.

The fact of the value of the Imports exceeding the value of the Exports, does not warrant the conclusion that the balance of payments is unfavourable.

The great object of the *mercantile* system of commercial policy, a system which still continues to preserve the ascendancy in this and in every other country in Europe, is, to create a favourable balance of payments, and, consequently, a favourable *real* exchange, by facilitating exportation and restricting importation. It is foreign to the object of this article to enter into any examination of the principles of this system, except in so far as they are connected with the subject of exchange; but we hope to be able to show, in opposition to the commonly received opinions on the subject, that in every country carrying on an advantageous commerce, the value of the imports must always exceed the value of the exports; and that this excess of importation has not, in ordinary cases, the least tendency to render the *real* exchange unfavourable.

In countries carrying on an advantageous commerce, the value of the Imports must always exceed the value of the Exports.

The proper business of the merchant consists in carrying the various products of the different countries of the world from those places where their exchangeable value is least to those where it is greatest; or, which is the same thing, in distributing them according to the effective demand. It is clear, however, that there could be no motive to export any commodity unless the commodity which it was designed to import in its stead was of greater value. When an English merchant commissions 100,000 quarters of Polish wheat, he calculates on its selling for so much more than its price in Poland, as will be sufficient to pay the expence of freight, insurance, &c.; and to yield, besides, the common and ordinary rate of profit on the capital employed in making the transfer. If the wheat did not sell for this sum, its importation would obviously occasion a loss to the importer. No merchant ever did or ever will export but with the view of importing a greater value in return. And so far from an excess of exports over imports being any criterion of an advantageous

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commerce, it is quite the reverse; and the truth is, notwithstanding all that has been said and written to the contrary, that unless the value of the imports exceeded the value of the exports, foreign trade could not be carried on. Were this not the case—were the value of the exports always greater than the value of the imports, merchants would lose on every transaction with foreigners, and the trade with them would either have no existence at all, or if begun, would have to be speedily relinquished.

In England, the rates at which exports and imports are valued, were fixed so far back as 1696. But the very great alteration that has since taken place, not only in the value of money, but also in the real price of most part of the commodities produced in this and other countries, has rendered this *official* valuation of no use whatever as a criterion of the true value of the exports and imports. In order to remedy this defect, an account of the real, or *declared* value of the exports is annually prepared and laid before Parliament; but even this is very far from accurate. It must always be the interest of the merchant to endeavour to conceal the real amount of the goods imported on which duties are charged; while, on the other hand, it is very frequently his interest to magnify the amount of those commodities on the export of which either a bounty or a drawback is allowed.

If perfectly accurate accounts could be obtained of the value of the exports and imports of a commercial country, there can be no manner of doubt that in ordinary years there would be always an excess of imports over exports. The value of an exported commodity is estimated at the moment of its being sent abroad, and *before* its value is increased by the expence incurred in transporting it to the place of its destination; but the value of the commodity imported in its stead is estimated *after* it has arrived at its destination, and, consequently, after its value has been enhanced by the cost of freight, insurance, importer's profit, &c.

It is of very little importance, in as far at least as the interests of commerce are concerned, whether a nation acts as the carrier of its own imports and exports, or employs others. A carrying nation will appear to derive a comparatively large profit from its commercial transactions; but this excess of profit is nothing more than a fair remuneration for the capital employed and the risk incurred in transporting commodities from one country to another. If the whole trade between this country and France was carried on in British bottoms, our merchants, in addition to the value of the goods exported, would also receive the expence of the carriage to France. This, however, would not occasion any loss to that country. The French merchants must pay the freight of the commodities they import; and if the English can afford it on cheaper terms than their own countrymen, there can be no good reason why they should not employ them in preference.

In the United States the value of the imports, as ascertained by the Customhouse returns, always exceeds the value of the exports. And although our practical politicians consider the excess of exports over imports as the only sure criterion of an advantageous commerce, " it is nevertheless true, that the real gain of the United States has been nearly in proportion as their imports have exceeded their exports."* This has in part been occasioned by the Americans generally exporting their own surplus produce, and consequently receiving from foreigners, not only an equivalent for their exports, but also for the cost of conveying them to the foreign market. In 1811, says the author just quoted, flour sold in America for nine dollars, 50 cents *per* barrel, and in Spain for 15 dollars. The value of the cargo of a vessel carrying 5000 barrels of flour would, therefore, be estimated at the period of its exportation at 47,500 dollars; but as this flour would, because of freight, insurance, exporter's profits, &c., sell in Spain for 75,000 dollars, the American merchant would be entitled to draw on his agent in Spain for 27,500 dollars more than the flour cost in America, or than the sum for which he could have drawn had the flour been exported on account of a Spanish merchant. If, as is most probable, the 75,000 dollars were invested in some species of Spanish or other European goods, the freight, insurance, &c., on account of the return cargo, would perhaps increase its value to 100,000 dollars, so that in all the American merchant might have imported commodities worth 52,500 dollars more than the flour originally sent to Spain. It is as impossible to deny that such a transaction as this is advantageous, as it is to deny that its advantage consists entirely in the excess of the value of the goods imported over those exported. And it is equally clear, that, although such transactions as the above had been multiplied to an inconceivable extent, America might notwithstanding have had the real balance of payments in her favour.

Instead, therefore, of endeavouring to fetter and restrict the trade with those countries from which we should otherwise import a greater value than we exported, we ought, on the contrary, to give it every possible facility. There is not a private merchant in the kingdom who does not consider that market as the best in which he is enabled to obtain the highest price, or the greatest value in exchange for his goods; why then should he be excluded from it? Why compel him to dispose of a cargo of muslin for L. 10,000 rather than L. 12,000? The wealth of a state is made up of the wealth of individuals; and it is impossible that any more effectual method of increasing individual wealth can be devised than to permit every person to make his purchases in the cheapest and his sales in the dearest market.

Erroneous notions relative to the balance of trade, have been the cause of the restrictions which have annihilated the trade with France.

It would be difficult to estimate the mischief which absurd notions relative to the balance of trade have occasioned in almost every commercial country. In Great Britain, they have been particularly injurious. It is owing entirely to the prevalence of prejudices to which they have given rise, that the restrictions imposed on the trade between this country and France are to be ascribed. The great, and, indeed, the only argument insisted on by those who prevail-

* Pitkin on the *Commerce of the United States*, 2d Ed. p. 280.

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ed on the Legislature to declare the trade with France a *nuisance* (*Prohibition Act, 1st William and Mary*), was founded on the fact, that the value of the imports from that kingdom considerably exceeded the value of the commodities we had exported! This balance was termed a *tribute* paid by England to France; and it was sagaciously asked, what had we done that we should be obliged to pay so much money to our deadly enemy? It never occurred to these wise persons, that no merchant would import a single ounce of any commodity from France, unless it would bring a higher price in this country than the commodity with which it had been bought; and that the profit of the merchant, or, which is the same thing, the national gain, would be in exact proportion to this excess of price. The very reason assigned for prohibiting the trade affords the best possible proof of its having been a lucrative one. Nor can there be any doubt that an unrestricted freedom of intercourse between the two countries would still be of the greatest service to both. The peculiarities in the soil and climate, as well as in the national character of the people of Great Britain and France, will always enable the one to produce various species of raw and manufactured commodities at a cheaper rate than they could possibly be produced by the other. If we were allowed freely to purchase the silks, the wines, and the brandies of France, those commodities which we can produce at a cheaper rate than our ingenious neighbours would be taken in payment. An extensive market would thus be created for many species of our commodities, and a natural and powerful stimulus would be applied to the industry of both countries. Nobody will be hardy enough to deny that the trade with America, Portugal, and the Baltic is advantageous; and, if so, what possible reason can be given why the trade with France should be considered as prejudicial? Surely no person can be silly enough to suppose that our merchants would export or import any commodity to or from France, which they could either sell or buy on better terms any where else. If the restrictions on the French trade are not really injurious, that is, if the trade be either a losing or a less advantageous one than the trade with other countries, we may rest assured that the throwing it open would not induce a single merchant to engage in it.

As the real price of every species of commodities must always be proportionable not only to the expence of their production, but also to the expence necessarily incurred in conveying them from where they have been produced to where they are to be consumed, it is certain that a nation which prohibits trading with the countries in her immediate vicinity must pay a higher price for her imported commodities, and be obliged to exact a higher price for those which she exports, than would have been necessary had she been able to procure the one, or to dispose of the other, in her immediate neighbourhood. If wine of the same intrinsic worth could be bought at Bourdeaux equally cheap as at Lisbon, the difference of freight would enable it to be sold cheaper in London. It is this principle, in fact, which renders the home trade so peculiarly advantageous. The parties who make the exchange live near each other, and, consequently, each obtains the commodity of which he stands in need at its cheapest rate, and without being obliged to pay any great additional sum on account of carriage. When, therefore, we restrict the trade with countries in our immediate vicinity, we act in the teeth of that very principle which is, in every other case, admitted to be advantageous. We compel the purchasers of foreign commodities to pay a higher price for them than would otherwise have been necessary; while, by raising the price of our own exported commodities, the market for them is unnaturally and injuriously contracted.

But the partisans of the exclusive or mercantile system will perhaps tell us, that they do not mean to contend, that it is profitable to export a greater actual value than is imported, but that, by exporting an excess of raw and manufactured commodities, the balance of payments is rendered favourable, and that this balance (which they consider as equivalent to the entire nett profit made by the country in its transactions with foreigners) is always paid in *bullion*.

Favourable or unfavourable balance not always received or paid in Bullion.

It will, however, be an extremely easy task to show that this statement is altogether erroneous; that an unfavourable balance is seldom or never discharged by means of bullion; and that this balance is not a measure, and has, in fact, nothing to do with the profit or loss attending foreign commercial transactions.

1. As long as the premium on foreign bills is less than the expence attending the transit of bullion from a country which has an unfavourable real exchange, it is certain that no merchant will ever think of subjecting himself to an unnecessary expence, by exporting bullion to pay a foreign debt. But supposing the premium on foreign bills to have increased, so as to equal the cost of exporting the precious metals, for it cannot *exceed* this sum, it does not by any means follow that they will therefore be exported. That depends entirely on the fact, whether bullion is, at the time, the cheapest exportable commodity, or, in other words, whether a remittance of bullion is the most advantageous way in which it is possible to discharge a debt. If a London merchant owes a debt of L. 100 in Paris, it is his interest to find out the cheapest method of paying it. On the supposition, that the *real* exchange is 2 *per cent.* below *par*, and that the expence of remitting bullion, including the profit of the bullion merchant, is also 2 *per cent.*, it will be indifferent to the London merchant, whether he pays L. 2 of premium for a bill of L. 100 payable in Paris, or incur an expence of L. 2, by remitting L. 100 worth of bullion directly to that city. If the relative prices of cloth in Paris and London are such, as would require L. 103 to purchase and pay the expence of sending as much cloth to Paris as would sell for L. 100, he would undoubtedly prefer buying a bill, or exporting bullion. But if, by incurring an expence of L. 101, the debtor is enabled to send as much hardware to Paris as would sell for L. 100, he would as certainly prefer paying his debt by an exportation of hardware. By doing so, he would save 1 *per cent.* more than if he had bought a foreign bill, or remitted bullion, and 2 *per cent.* more than

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if he had exported cloth. If there had been any other commodity whose exportation would have been more advantageous, he would have used it in preference.

It is obvious, therefore, that the exportation of bullion is regulated by precisely the same principles which regulate the export and import of other commodities. It is exported when its exportation is most advantageous; that is, when it is less valuable at home, and more valuable abroad, than any other commodity; and it cannot possibly be otherwise exported. The balance of payments might be a thousand millions against a particular country, without causing the exportation of a single ounce of bullion. No merchant would remit L. 100 worth of gold or silver from England to discharge a debt in Paris, if he could invest L. 99, L. 98, or any smaller sum in any other species of merchandise which, exclusive of expences, would sell in France for L. 100. The merchant who deals in the precious metals is, we may depend upon it, as much under the influence of self-interest, as the merchant who deals in coffee or indigo. But what merchant would attempt to discharge a foreign debt, by exporting coffee which cost L. 100, when he might effect the same object by sending abroad indigo which cost only L. 95? No person in his senses would export a hat to be sold for 20s., provided he could sell it at home for a *guinea;* nor would any person export an ounce of bullion, if its value was not less in the exporting than in the importing country, or if there was any other commodity, whatever that might be, exported with greater advantage.

2. It is in vain to contend, that, by permitting an unrestricted freedom of trade, a particular state might become indebted to another, which had no demand for any species of ordinary merchandise, and which would only accept of cash or bullion in exchange for its exports. Such a case never did, and never will occur. A nation which is in want of money, must also be in want of other commodities; for men only desire money, because of its being the readiest means of increasing their command over the necessaries and enjoyments of life. The extreme variety, too, in the soil and climate, in the powers and perfection of the machinery, and in the skill and industry of the artisans belonging to different countries, must always occasion a considerable difference in the real price of their commodities. But until the cost of production shall have been equalized, there must always be a demand in one country for those commodities which can be produced cheaper in another; and until the desire to accumulate shall be banished from the human breast, there must always be an inclination to import commodities from those countries, where their exchangeable value is least to where it is greatest.

3. In treating of the *nominal* exchange, we endeavoured to show, that it is impossible that any country should be able, for any length of time, to import or export a greater quantity of bullion, than would be necessary to preserve the value of bullion in that country, in its proper relation to the value of bullion in other countries; or, which is the same thing, to have the *real* exchange either highly favourable or unfavourable. But although this principle is strictly true in reference to its *aggregate* exchanges, it is incorrect when the state of its exchange with one country only is considered. Great Britain, for example, may constantly have the exchange in her favour with Portugal, provided she has it constantly, and to an equal extent, against her with the East Indies, or some other country. "She may," to use the words of Mr Ricardo, "be importing from the north the bullion which she is exporting to the south. She may be collecting it from countries, where it is relatively abundant for others, where it is relatively scarce, or where, from some particular causes, it is in great demand. Spain, who is the great importer of bullion from America, can never have an unfavourable exchange with her colonies; and as she must distribute the bullion she receives among the different nations of the world, she can seldom have a favourable exchange with the countries with which she trades." *

It was by this principle that Lord King ingeniously, and, we think, successfully accounted for the nearly continued favourable exchange between this country and Hamburgh, from 1770 to 1799. His Lordship showed that the importation of bullion from Hamburgh and other countries was only equivalent to the quantity exported to the East Indies, and consumed at home; that the demand corresponded to the supply, and consequently that its relative value remained stationary. The extraordinary influx of bullion into this country from the Continent at the era of the restriction, and the very favourable state of the exchange, was undoubtedly owing, in a very great degree, to the then reduction in the issues of Bank paper, and to the diminution of the gold currency caused by the hoarding of guineas, &c. In 1797 and 1798, above *five* millions of guineas were coined at the mint; and this extraordinary demand for gold is of itself abundantly sufficient to account for the very favourable exchange of that period, and for the length of time which it continued. But, at the same time that the demand for *gold* bullion for the mint had been thus increased, the demand for *silver* bullion, for the purpose of exportation by the East India Company, had also been proportionably augmented. In 1795, the quantity exported on account of the Company, and of private persons, amounted

to only . .	151,795 ounces.
In 1796, to . .	290,777
1797, . .	962,880
1798, . .	3,565,691
1799, . .	7,287,327

From this period, the exportation of silver to the East Indies was very much reduced; and, in the years in which the exchange was most unfavourable, it had almost entirely ceased.

Instead, therefore, of the extraordinary importation of bullion from Hamburgh in 1797 and 1798 affording, as Mr Bosanquet and others have sup-

* See *Reply to Mr Bosanquet's Observations on the Report of the Bullion Committee*, p. 17,—one of the best pamphlets that has ever been published on the subject of Exchange.

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posed, a practical proof of the fallacy of the opinion of those who contend that it is impossible, for any length of time, to destroy the natural equilibrium in the value of bullion in different countries, it is in itself a striking example of its truth. Without this influx of bullion, its value, in this country, could not have maintained its proper relation to its value in other countries. We imported bullion because, owing to the reduction of our paper currency, and the increased demand by the East India Company, its value was rendered higher here than in the Continent; and, consequently, because the Continental merchants found it advantageous to send bullion to this country, in the same manner as they would have sent corn, or any other commodity for which there was an unusual demand in Great Britain. For, however favourable the *real* exchange between Hamburgh and London might have been to the latter, we should not have imported a single ounce of bullion had it not been, at the time, the most advantageous article with which Hamburgh could discharge its debt to London.

4. In the absence of all other arguments, it would be sufficient to state, that it is physically impossible the excess of exports over imports, as indicated by the Customhouse Returns, can be paid in bullion. Every country in the world, with the single exception of the United States, has its favourable balance; and, of course, they must be paid by an annual influx of bullion from the mines corresponding to their aggregate amount. It is certain, however, that the entire produce of the mines, though it were increased in a *tenfold* proportion, would be insufficient for this purpose! This, of itself, is decisive of the degree of credit which ought to be attached to the commonly received opinions on this subject.

5. In the last place, the profit on our transactions with foreigners consists not in the quantity of bullion imported from abroad; but in "the excess of the value of the entire imports over the value of the entire exports." If in return for an exportation of commodities worth *ten* or *twenty* millions, we import commodities worth *fifteen* or *thirty*, we shall, provided money has not altered in value, gain 50 *per cent*. by the transaction, and that although the exports should have consisted entirely of bullion, and the imports of corn, sugar, coffee, &c. It is a ridiculous prejudice that would induce us to import bullion rather than any other commodity. But whatever the partisans of the exclusive system may say about its being a *preferable product*, a *marchandise par excellence*, we may be assured that it will never appear in the list of exports or imports, while there is any other commodity whatever with which to carry on trade that will yield a larger profit.

Thus it appears, that the excess of exports over imports, instead of being any proof of an advantageous commerce, is distinctly and completely the reverse;—that a commercial country may, and almost always does, import commodities of a greater value than it exports, without rendering itself indebted to foreigners:—And that, when a balance of debt has been contracted, that is, when the sum *payable to* foreigners for the commodities imported from abroad is greater than the sum *receivable from* them for the commodities they export, the balance will not be paid by an exportation of bullion from the debtor to the creditor country, unless bullion be the most profitable article of export.

Effect of fluctuations in the Real Exchange on Foreign Trade.

We have, in the previous *section*, shown that fluctuations in the nominal exchange have no effect on foreign trade. When the currency is depreciated, the premium which the exporter of commodities derives from the sale of the bill drawn on his correspondent abroad, is only equivalent to the increase in the price of the goods exported, occasioned by this depreciation. But when the premium on a foreign bill is a consequence not of a fall in the value of money, but of a deficiency in the supply of bills, there is no rise of prices; and in these circumstances the unfavourable exchange undoubtedly operates as a stimulus to exportation. As soon as the *real* exchange diverges from *par*, the mere inspection of a price current is no longer sufficient to regulate the operations of the merchant. If it is unfavourable, the premium which the exporter will receive on the sale of his bill must be included in the estimate of the profit he is likely to derive from the transaction. The greater that premium the less will be the difference of prices necessary to induce him to export. And hence an unfavourable *real* exchange has an effect exactly the same with what would be produced by granting a bounty on exportation equal to the premium on foreign bills.

But for the same reason that an unfavourable *real* exchange increases exportation, it must proportionably diminish importation. When the exchange is really unfavourable, the price of commodities imported from abroad must be so much lower than their price at home, as not merely to afford, exclusive of expences, the ordinary profit of stock on their sale, but also to compensate for the premium which the importer must pay for a foreign bill if he remits one to his correspondent, or for the discount, added to the invoice price, if his correspondent draws upon him. A much less quantity of foreign goods will, therefore, suit our market when the *real* exchange is unfavourable, and fewer payments having to be made abroad, the competition for foreign bills will be diminished, and the *real* exchange rendered proportionably favourable. In the same way, it is easy to see, that a favourable *real* exchange must operate as *duty* on exportation, and as a *bounty* on importation.

It is thus that fluctuations in the *real* exchange have a necessary tendency to correct themselves. They can never, for any considerable period, *exceed* the expence of transmitting bullion from the debtor to the creditor country. But the exchange cannot continue either permanently favourable or unfavourable to this extent. When favourable, it corrects itself by restricting exportation and facilitating importation, and when unfavourable, it produces the same effect by giving an unusual stimulus to exportation, and by throwing obstacles in the way of importation. The true PAR forms the centre of these oscillations, and although the thousand circumstances which are daily and hourly affecting the state of debt and credit, prevent the ordinary course of exchange from

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being almost ever precisely at *par*, its fluctuations, whether on the one side or the other, are confined within certain limits, and have a constant tendency to disappear.

This natural tendency which the exchange has to correct itself, is powerfully assisted by the operations of the bill-merchants.

The operations of the Bill Merchants have a tendency to lessen Fluctuations in the *real* Exchange.

England, for example, might owe a large excess of debt to Amsterdam, yet, as the aggregate amount of the debts *due* by a commercial country, is generally balanced by the amount of those which it has to receive, the deficiency of bills on Amsterdam in London would most probably be compensated by a proportionable redundancy of them in some other quarter. Now, it is the business of the merchants who deal in bills, in the same way as of those who deal in bullion or any other commodity, to buy them where they are cheapest, and to sell them where they are dearest. They would, therefore, buy up the bills drawn by other countries on Amsterdam, and dispose of them in London; and by so doing, would prevent any great fall in the price of bills on Amsterdam in those countries in which the supply exceeded the demand, and any great rise in Great Britain and those countries in which the supply happened to be deficient. In the trade between Italy and this country, the bills drawn on Great Britain amount almost invariably to a greater sum than those drawn on Italy. The bill-merchants, however, by buying up the excess of the Italian bills on London, and selling them in France, Holland, and other countries indebted to England, prevent the *real* exchange from ever becoming very much depressed.

A large Foreign Expenditure has no permanent effect on the Exchange.

An unusual deficiency in the supply of corn, or of any other article of prime necessity, the demand for which could not be immediately contracted, by causing a sudden augmentation of the imports from abroad, must always materially affect the state of debt and credit with foreign countries, and depress the exchange. In time of war the balance of payments is liable to be still further deranged; the amount of the bills drawn on a country carrying on foreign hostilities, being increased by the whole expence of the armaments abroad and of subsidies to foreign powers. But neither the conjoined nor separate influence of both or either of these causes, can exert any permanent influence on the exchange. A sudden increase in the accustomed supply of bills, must, in the first instance, by glutting the market, occasion their selling at a discount; but this effect can only be of a very temporary duration. The unusual facilities, which are then afforded for the exportation of manufactured produce to the foreign market, and the difficulties which are thrown in the way of importation, never fail speedily to bring the *real* exchange to *par*.

In a period of profound peace we may, by exporting an excess of raw or manufactured produce, overload the foreign market, and occasion such a decline in the price of British goods abroad, as to render the imported less valuable than the exported commodities with which they have been purchased. But such a state of things must speedily operate its own cure. The distress which it necessarily occasions would lead to an immediate diminution of exports; and the supply of British commodities in the foreign market being thus rendered more nearly commensurate with the demand, they would, of course, sell for an adequate profit, and, in consequence, the entire value of the imports would again exceed, as it always ought to do, the entire value of the exports. But whenever a country has a large foreign expenditure to sustain, its exports must be proportionably augmented. Such an expenditure can only be discharged either by the Government directly sending abroad an equivalent amount of commodities, or by means of bills of exchange drawn on account of produce exported by private individuals. Supposing the foreign expenditure of Great Britain during the late war to have amounted to ten or twenty millions a-year, it is evident we must have annually exported an equal amount of the produce of our land, capital, and labour, for which payment would be received, not, as in ordinary cases, by a corresponding importation of foreign commodities, but from the treasury at home. This is strictly true, even though it were admitted that the expenditure had, in the first instance, been entirely discharged by remittances of bullion; for the increased supply of bullion which would thus have been required, could only have been obtained by an equally increased exportation of other produce to the countries possessed of mines, or from which it could be advantageously imported. Foreign expenditure increases the amount of the exports precisely in proportion to its own amount, and is therefore incapable of exerting any permanent effect on the exchange.

Thus, it appears that a great excess of exports instead of being any criterion of increasing wealth at home, is only a certain indication of great expenditure abroad. "When," says Mr Wheatley, "the exports exceed the imports, as they must do when there is a large foreign expenditure, the equivalents for the excess are received abroad in as full and ample a manner as if the produce which they purchased were actually imported and entered in the customhouse books, and afterwards sent to the seat of war for consumption. But from the circumstance of its not being inserted in the customhouse entries as value received against the produce exported for its payment, the latter is deemed to constitute a favourable balance, when it is in reality exported to liquidate a balance against us." (Wheatley *On the Theory of Money*, p. 219.)

Cause of the Rise of the Exchange in 1815 and 1816.

But however conclusive this reasoning may appear, it has, nevertheless, been strenuously contended that it is at *variance with the fact*; and that the rise of the exchange in autumn 1814, and its restoration to *par* in 1816, when the restriction on cash payments was in full operation, is a practical and convincing proof that its previous depression had been a consequence not of the depreciation of the currency, but of the excessive supply of bills on London in the foreign market, occasioned by the expensive contest in which we were then engaged. According to our view of the matter, however, this fact leads to a precisely opposite conclusion. It is of no use to tell us that the exchange came to *par*, while the restriction act was unrepealed. It was never contended, that

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the simple fact of such a law being in existence, could have any effect in depreciating the currency. The restriction was condemned, and justly condemned, because it *enabled* the Bank of England to deluge the country with paper. If the Bank had never abused that power,—if the proprietors had sacrificed their own direct, palpable, and individual interests to those of the public, and had constantly kept their paper on a level with bullion, the restriction act, though unwise, would, as to consequences, have been the same as if it had never existed. The question is not, therefore, whether the exchange came to *par*, while the restriction continued, but *whether it came to* PAR, *while as many notes circulated as in the period of its greatest depression?* If this could be shown, and if it could also be shown that the effective demand for paper had not, at the same time, been proportionably increased, the argument would be conclusive; and we should be compelled to admit that a great comparative increase of paper money has no tendency to diminish its value, or to render the *nominal* exchange unfavourable!

But it would be worse than idle to set about proving by argument a fact so notorious as the prodigious diminution of bank paper in 1814, 1815, and 1816. In that period above 240 country banks became altogether bankrupt, or at least stopped payments; and the issues of the remainder were very much diminished. The Board of Agriculture estimated, that, in the county of Lincoln alone, above *three* millions of bank paper had been withdrawn from circulation; and the total diminution of the currency during the three years in question has seldom been estimated at less than *sixteen* or *twenty* millions, though it probably amounted to a great deal more. Mr Horner, the accuracy and extent of whose information cannot be called in question, made the following statement on this subject, in his place in Parliament:

" From inquiries he had made, and from the accounts on the table, he was convinced that *a greater and more sudden reduction of the circulating medium had never taken place in any country than had taken place since the peace in this country*, with the exception of those reductions that had taken place in France after the Mississippi scheme, and after the destruction of the assignats. The reduction of the currency had originated in the previous fall of the prices of agricultural produce. That fall had produced a destruction of country-bank paper, to an extent which would not have been thought possible, without more ruin than had actually ensued. The Bank of England had also restricted its issues. As appeared by the accounts recently presented, the average amount of its currency was not, during the last year, more than between L. 25,000,000 and L. 26,000,000; while two years ago it had been nearer L. 29,000,000, and at one time even amounted to L. 31,000,000. But without looking to the diminution of Bank of England paper, the reduction of the country paper was enough to account for the rise which had taken place in the exchange."

Here, then, is the true cause of the exchange coming to *par* in 1815 and 1816. It had nothing to do with the cessation of hostilities, but was entirely a consequence of the increased value of our currency, caused by the sudden reduction of its quantity. Instead, therefore, of being at variance with the principles we have been endeavouring to elucidate, this fact affords the strongest possible confirmation of their perfect correctness. And having been sanctioned by the fullest experience, they may now be considered as placed beyond the reach of cavil and dispute.

An objection of a different sort has been made by a very able economist to another part of the theory maintained in this *section*, of which it will here be proper to take some notice.

Refutation of the opinion, that, during an unfavourable real Exchange, Commodities of great value and small bulk are exported in preference to others.

When the exchange becomes unfavourable, the premium, procured by the sale of the bill drawn on a foreign merchant to whom bullion has been consigned, is no greater than would have been obtained by consigning to him a quantity of coffee, tea, sugar, indigo, &c., of equal value. An unfavourable *real* exchange will permit a merchant to export commodities which could not be exported were the *real* exchange at *par*, or favourable; but the advantage still remains of exporting those commodities in preference, whose price in the country from which they are exported, compared with their price in the country into which they are imported, is lowest. Suppose, for example, that the expence of transmitting bullion from this country to France is *three per cent.*, that the *real* exchange is *four per cent.* against us, that the price of bullion is the *same* in both countries, and that coffee, exclusive of the expences of carriage, is really worth *four per cent.* more in France than in England. In such a case, it is obvious, the exporter of bullion would realize only a profit of *one per cent.*, while the exporters of coffee would realize, inclusive of the premium on the sale of the foreign bill, a profit of *seven per cent.* And hence the opinion maintained by Colonel Torrens (*Comparative Estimate, &c.*), that when the exchange becomes unfavourable, those commodities which contain the greatest value in the smallest bulk, or on which the expence of carriage is least, would be exported in preference, appears to rest on no good foundation. The relative value of the commodities which nations trading together are in the habit of exporting and importing, is regulated not merely by the cost of their production, but also by the expence necessarily incurred in carrying them from where they are produced to where they are consumed. If Great Britain were in the constant habit of supplying France with corn and bullion the average price of corn in France, because of the expence required to convey it to this country, would plainly be from 10 to 15 *per cent.* higher than in Britain, while, because of the comparative facility with which bullion might be transported from the one to the other, its value in Paris would not exceed its value in London more than 2 or 3 *per cent.* Now, supposing, that when the prices of both corn and bullion in Great Britain and France are adjusted according to their natural proportions, the *real* exchange becomes unfavourable to this country, it is clear, that this fall in the exchange can give no advantage to the exporters of bullion more than it gives to the exporters of corn. The rise in the price of foreign bills does not increase

Real Exchange.

the expence attending the exportation either of corn or bullion. It leaves the cost of production and of the transportation of those commodities between the two countries exactly where it found them. During the depression of the exchange, the exporter of bullion, equally with the exporter of corn, will derive a premium from the sale of the bill drawn on his correspondent abroad. But there can be no possible inducement to export bullion in preference to corn, unless the real price of bullion should increase more rapidly in France, or decline more rapidly in Great Britain, than the real price of corn.

Whatever, therefore, may be the depression of the exchange, the merchant, as in every other case, selects those commodities for exportation, which will, exclusive of the premium, yield the greatest profit on their sale. If bullion is one of these commodities it will, of course, be exported, if not, not. Bullion, however, is of all other commodities that of which the relative value approaches nearest to an equilibrium in different countries, and hence it is the least likely to be exported during an unfavourable exchange. The demand for bullion is comparatively steady, and no great surplus quantity could be imported into one country without reducing its value, or exported from another without raising its value, so as to unfit it either for exportation or importation. A very small part only of an unfavourable balance is ever paid in bullion. The operations of the bullion merchant are chiefly confined to the distribution of the fresh supplies which are annually dug from the mines proportionably to the effective demand of different countries. Its price is too invariable, or, which is the same thing, its supply and demand are too constant, to admit of its ever becoming an important article in the trade between any two countries neither of which are in possession of mines.

In corroboration of this argument, we may mention that, according to the official statement laid on the table of the House of Commons, it appears that the expences incurred by this country on account of the armies acting in Portugal and Spain during the following years, were as under:

In 1808,	-	-	L. 2,903,540
9,	-	-	2,450,956
10,	-	-	6,066,021
11,	-	-	8,906,700
12, } 13, }	-	-	31,767,794
14,	-	-	13, —, —

Of which, according to the same official statement, only the following sums were remitted in coin or bullion:

In 1808,	-	-	L.2,861,339
9,	-	-	461,926
10,	-	-	697,675
11,	-	-	748,053
12, } 13, }	-	-	3,284,435

Of the sum of *five* millions voted to our allies in 1813 and 1814, not more than L. 300,000 was sent in bullion, the rest being made up by the exportation of manufactured goods and military stores. (*Edinburgh Review*, Vol. XXVI. p. 154.) The high market price of gold and silver in 1809, 1810, &c. could not, therefore, be owing to the purchases made by Government, for they were not greater than the sums exported by the East India Company in 1798 and 1799, and in 1803, 1804, and 1805, when there was scarcely any perceptible rise in the price of bullion. The immense additions made to the paper currency of the country in 1809, 1810, &c. sunk its value compared with bullion, and was the true cause of the unfavourable *nominal* exchange of that period.

Computed Exchange.

Section III.—*Computed Exchange.*

Computed Exchange.

Having thus endeavoured to point out the manner in which variations in the comparative value of the currencies of nations trading together, and in the supply and demand for bills, separately affect the exchange, it now only remains to ascertain their combined effect. It is on this that the *computed*, or actual course of exchange depends.

The computed Exchange represents either the *sum* or the *difference* of the real and nominal Exchange.

From what we have already stated, it must be obvious, that when the nominal and real exchange are both favourable or both unfavourable, the *computed* exchange will express their *sum*; and that when the one is favourable and the other unfavourable, it will express their *difference*.

When, for example, the currency of Great Britain is of the mint standard and purity, and the currency of France 5 *per cent.* degraded, the *nominal* exchange will be 5 *per cent.* in favour of this country. But the *real* exchange may, at the same time, be either favourable or unfavourable. If it be also favourable to the extent of 1, 2, 3, &c. *per cent.* the computed exchange will be 6, 7, 8, &c. *per cent.* in favour of this country. And, on the other hand, if it is unfavourable to the extent of 1, 2, 3, &c. *per cent.* the *computed* exchange will be only 4, 3, 2, &c. *per cent.* in our favour. When the *real* exchange is in favour of a particular country, provided the *nominal* exchange be equally against it, the *computed* exchange will be at *par*, and *vice versa.*

A comparison of the market with the mint price of bullion, affords the best criterion whereby to ascertain the state of the exchange at any particular period. When no restrictions are imposed on the trade in the precious metals, the excess of the market over the mint price of bullion, affords a pretty accurate measure of the depreciation of the currency. If the market and mint price of bullion at Paris and London exactly corresponded, and if the value of bullion was the same in both countries, the *nominal* exchange would be at *par;* and whatever fluctuations the computed exchange might exhibit, must be traced to fluctuations in the *real* exchange, or, which is the same thing, in the supply and demand for bills. If, when the market price of bullion in Paris is equal to its mint price, it exceeds it 10 *per cent.* in London, it is a proof that our currency is 10 *per cent.* depreciated, and consequently the *nominal* exchange between Paris and London *must* be 10 *per*

Computed Exchange.

cent. against the latter. Instead, however, of the *computed*, or actual course of exchange, being 10 *per cent.* against London, it may either be against it to a greater or less extent, or in its favour. It will be more against it provided the *real* exchange is also unfavourable,—it will be less against it provided the *real* exchange be in favour of London, though to a less extent than the adverse *nominal* exchange,—and it will be in favour of London, should the favourable *real* exceed the unfavourable *nominal* exchange. Thus, if while the value of British was 10 *per cent.* less than the value of French currency, the *computed* or actual course of exchange between Paris and London was 12 or 15 *per cent.* against the latter, it would show that the *real* exchange was also against this country to the extent of 2 or 3 *per cent.* And if, on the other hand, the computed exchange was only 5 or 6 *per cent.* against London, it would show that the *real* exchange was 4 or 5 *per cent.* in its favour, and so on.

It has already been shown, that, in so far, at least, as the question of exchange is involved, the differences between the value of bullion in different countries are limited by the expence of transit from the one to the other. And hence, by ascertaining whether a particular country is in the habit of exporting or importing bullion to or from other countries, we are enabled to determine its comparative value in these countries. Supposing, for example, that the expence of conveying bullion from this country to France, including the profits of the bullion dealer, is equivalent to 2 *per cent.*, it is clear, inasmuch as bullion is only exported *to find its level*, that whenever our merchants begin to export bullion to France, its value there must be 2 *per cent.* greater than in England; and, on the contrary, when they import bullion from France, its value in this country must be 2 *per cent.* greater than its value in France. In judging of the state of the exchange between any two countries, this circumstance must always be attended to. If no bullion be passing from the one to the other, we may conclude that its value is nearly the same in both countries; at all events, it is certain that the difference of its value is *less* than the expence of transit. On the supposition, that the entire expence, including profit, &c. of conveying bullion from Rio Janeiro to London is 5 *per cent.*, and that the London merchants are importing bullion, then it is clear, provided the real exchange is at *par*, and that the currency of both cities is at the Mint standard, that the *nominal*, or which, in this case, is the same thing, the *computed* exchange will be 5 *per cent.* in favour of London. But if the currency of London is 5 *per cent.* depreciated, or, in other words, if the market price of bullion at London is 5 *per cent.* above its mint price, the *computed* exchange between it and Rio Janeiro, supposing the *real* exchange to continue at *par*, will obviously also be at *par*. It may, therefore, be laid down as a general rule, that as soon as bullion begins to pass from one country to another, *the expence of transit*, provided the mint and market price of bullion in the *exporting* country correspond, will indicate how much the value of its bullion falls short of the value of bullion in the country into which it is imported; or, which is the same thing, will be equal to its unfavourable *nominal* exchange; and that, when the market exceeds the mint price of bullion in the *exporting* country, the expence of transit, *added* to this excess, will give the total comparative reduction of the value of the precious metals in that country. The converse of this takes place in the country *importing* bullion. When its currency is of the mint standard, the expence of transit measures the extent of its favourable *nominal* exchange; but when its currency is relatively redundant or degraded, the *difference* between the expence of transit and the excess of the market above the mint price of bullion, will measure the extent of the favourable or unfavourable *nominal* exchange.—It will be favourable when the depreciation is less than the expence of transit, and unfavourable when it is greater.

State of the Exchange between Great Britain and the Continent, from 1809 to 1815.

From 1809 to 1815 inclusive, Great Britain continued to export gold and silver to the Continent. During this period, therefore, we must add the expences attending its transit to the excess of the market over the mint price of bullion, in order to ascertain the true relative value of British currency, and the state of the *real* exchange. Mr Goldsmid stated to the Bullion Committe that, during the last five or six months of the year 1809, the expence of transporting gold to Holland and Hamburgh, inclusive of freight, insurance, exporter's profits, &c. varied from 4 to 7 *per cent.* But, at the same time that the relative value of bullion in Britain was at $5\frac{1}{2}$ (medium of 4 and 7) *per cent.* below its value in Hamburgh, the market price of gold bullion exceeded its mint price to the extent of 16 or 20 *per cent.* or 18 *per cent.* on a medium; so that the currency of this country, as compared with the currency of Hamburgh, which differed very little from its mint standard, was really depreciated to the extent of $23\frac{1}{2}$ *per cent.* Now, as it appears from the tables annexed to this article, that the *computed* or actual course of exchange varied, during the same period, from 19 to 21 *per cent.* against London, it is clear that the *real* exchange could not be very different from *par*. Had the *computed* exchange been less unfavourable, it would have shown that the *real* exchange was in favour of London; had it been more unfavourable, it would, on the contrary, have shown that the *real* exchange was decidedly against London.

Causes of the Exportation of Bullion in 1809, 1810, &c.

Provided an accurate account could be obtained of the expence attending the transit of bullion from this country to the Continent during the subsequent years of the war, we have no doubt it would be found, notwithstanding the extraordinary depression of the *nominal*, that the *real* exchange fluctuated very little from *par*; and that the exportation of gold and silver was a consequence, not of the balance of payments being against this country, but of its being advantageous to export bullion, because of its being less valuable here than on the Continent. No person will contend that, in 1809, 1810, &c. there was such a redundancy of gold or silver currency in this country as to sink the relative value of these metals. Any such supposition is altogether out of the question. During the period referred to, the precious metals were sent out of the country, be-

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cause the depreciation of the paper currency exceeded the cost of the transit of bullion; and hence, because it was every body's interest to pay their debts in the depreciated currency, and to export that which was undepreciated to other countries where there was no law to prevent its passing at its full value as coin, or in which there was a greater demand for bullion. It is indisputably certain that, if our *paper-currency* had been sufficiently reduced, the supply of gold in the kingdom in 1809, 1810, &c. compared with the demand which must, in such circumstances, have been experienced, was so very small, that, instead of exporting, we should have imported the precious metals from every country in the world.

The unfavourable Exchange during the latter years of the War, no cause of the extraordinary Exportation of British produce to the Continent.

It has been very generally supposed, that the extraordinary exportation of British goods to the Continent during the latter years of the war, was in a great measure owing to the depression of the exchange. But, in so far as this depression was occasioned by the redundancy, or depreciation, of the currency, it could have no such effect. It is impossible, indeed, to form any opinion as to the influence of fluctuations in the *computed* exchange on export and import trade, without having previously ascertained whether they are a consequence of fluctuations in the *real* or *nominal* exchange. It is only by an unfavourable *real* exchange that exportation is facilitated; and it may be favourable at the very moment that the *computed* exchange is decidedly unfavourable. " Suppose," to use an example given by Mr Blake, " the computed exchange between Hamburgh and London, to be 1 *per cent.* against this country, and that this arises from a *real* exchange which is favourable to the amount of 4 *per cent.*, and a nominal exchange unfavourable to the extent of 5 *per cent.*; let the real price of bullion at Hamburgh and London be precisely the same, and, consequently, the *nominal* prices different by the amount of the *nominal* exchange, or 5 *per cent.*; now, if the expences of freight, insurance, &c. on the transit of bullion from Hamburgh are 3 *per cent.*, it is evident that a profit would be derived from the import of that article, notwithstanding the *computed* exchange was 1 *per cent.* against us. In this case, the merchant must give a premium of 1 *per cent.* for the foreign bill to pay for the bullion;—L. 100 worth of bullion at Hamburgh would therefore cost him L. 101, and the charges of importation would increase the sum to L. 104. Upon the subsequent sale, then, for L. 105 of depreciated currency in the home market, he would derive from the transaction a profit of L. 1. This sum is precisely the difference between the *real* exchange and the expences of transit, that part of the *computed* exchange which depends on the *nominal*, producing no effect; since whatever is lost by its unfavourable state, is counterbalanced by a corresponding inequality of *nominal* prices." (*Observations*, &c. p. 91.) In the same manner, it may be shown, that, notwithstanding the *computed* being favourable, the *real* exchange may be unfavourable; and that, consequently, it might be really advantageous to export, when it was apparently advantageous to import. But it would be tedious to multiply instances, which, as the intelligent reader will readily conceive, may be infinitely varied, and which have been sufficiently explained in the foregoing sections.

Negociation of Bills of Exchange.

The real cause of the extraordinary importation of British produce into the Continent in 1809, 1810, &c., notwithstanding the anticommercial system of Bonaparte, is to be found, not in the state of the exchange; for, inasmuch as that was occasioned by a fall in the value of the currency, it could have no effect whatever either in increasing or diminishing exportation; but in the annihilation of the neutral trade, and our monopoly of the commerce of the world. The entire produce of the East and of the West was placed at our sole disposal. The continental nations could neither procure colonial produce, nor raw cotton for the purposes of manufacturing, except directly from England. British merchandise was thus rendered almost indispensable; and to this, our immense exportation, in spite of all prohibitions to the contrary, is to be ascribed.—(See *Edinburgh Review*, No. LXIII. p. 50.)

Negociation of Bills of Exchange.

Manner of negociating Bills of Exchange.

In conducting the business of exchange a direct remittance is not always preferred. When a merchant in London, for example, means to discharge a debt due by him in Paris, it is his business to ascertain, not only the state of the direct exchange between London and Paris, and, consequently, the sum which he must pay in London for a bill on Paris equivalent to his debt, but also the state of the exchange between London and Hamburgh, Hamburgh and Paris, &c.; for it frequently happens, that it will be more advantageous for him to buy a bill on Hamburgh, Amsterdam, or Lisbon, and to direct his agent to invest the proceeds in a bill on Paris, rather than remit directly to the latter. This is termed the ARBITRATION of exchange. An example or two will suffice to show the principle on which it is conducted.

Arbitration of Exchange.

Thus, if the exchange between London and Amsterdam be 35s. Flemish *per* pound Sterling, and between Paris and Amsterdam 1s. 6d. Flemish *per* franc, then, in order to ascertain whether a direct or indirect remittance to Paris would be most advantageous, we must calculate what would be the value of the franc in English money if the remittance were made through Holland; for if it be less than that resulting from the direct exchange, it will obviously be the preferable mode of remitting. This is determined by stating, as 35s. Flem. (the Amsterdam currency in a pound Sterling): 1s. 6d. Flem. (Amsterdam currency in a franc) : : L. 1 : 10d. the proportional, or *arbitrated* value of the franc.—Hence if the English money, or bill of exchange, to pay a debt in Paris were remitted by Amsterdam, it would require 10d. to discharge a debt of a franc, or L. 1 to discharge a debt of 24 francs: And, therefore, if the exchange between London and Paris was at 24, it would be indifferent to the English merchant whether he remitted directly to Paris, or indirectly *via* Amsterdam; but if the exchange between London and Paris was *above* 24, then a direct remittance would be preferable; while, if, on the other hand, the direct exchange was less than

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24, the indirect remittance ought as plainly to be preferred.

"Suppose," to borrow an example from Dr Kelly (*Universal Cambist*, Vol. II. p. 137), "the exchange of London and Lisbon to be at 68d. *per* milree, and that of Lisbon on Madrid 500 rees *per* dollar, the arbitrated price between London and Madrid is 34d. Sterling *per* dollar; for as 1000 rees : 68d. :: 500 rees to : 34d. But if the direct exchange of London on Madrid be 35d. Sterling *per* dollar, then London, by remitting directly to Madrid, must pay 35d. for every dollar; whereas, by remitting through Lisbon, he will pay only 34d.; it is, therefore, the interest of London to remit indirectly to Madrid through Lisbon. On the other hand, if London draws directly on Madrid, he will receive 35d. Sterling *per* dollar; whereas, by drawing indirectly through Lisbon, he would receive only 34d.; it is, therefore, the interest of London to draw directly on Madrid. Hence the following rules:

1. Where the *certain price* is given, draw through the place which produces the lowest arbitrated price, and remit through that which produces the highest.

2. Where the *uncertain price* is given, draw through that place which produces the highest arbitrated price, and remit through that which produces the lowest."

In Compound Arbitration, or when more than *three* places are concerned, then, in order to find how much a remittance passing through them all will amount to in the last place, or, which is the same thing, to find the arbitrated price between the first and the last, we have only to repeat the different statements in the same manner as in the foregoing examples.

Thus, if the exchange between London and Amsterdam be 35s. Flem. for L. 1 Sterling; between Amsterdam and Lisbon 42d. Flem. for 1 old crusade; and between Lisbon and Paris 480 rees for 3 francs, What is the arbitrated price between London and Paris?

In the first place, as 35s. Flem. : L. 1 :: 42d. Flem. : 2s. Sterling, = 1 old Crusade.

Second as 1 old Crusade, or 400 rees : 2s. Sterling :: 480 rees : 2s. $4\frac{4}{5}$d Sterling, = 3 francs.

Third, as 2s. $4\frac{4}{5}$d. Sterling : 3 francs : : L. 1 Sterling : 25 francs, the arbitrated price of the pound Sterling between London and Paris.

This operation may be abridged as follows:

		L. 1 Sterling.
L. 1 Sterling	=	35s. Flemish.
$3\frac{1}{2}$ shillings Flem.	=	1 old Crusade.
1 old Crusade	=	400 Rees.
480 Rees	=	3 Francs.

$$\text{Hence } \frac{35 \times 400 \times 3}{480 \times 3\frac{1}{2}} = \frac{4200}{168} = 25 \text{ francs.}$$

This abridged operation evidently consists in arranging the terms so that those which would form the divisors in continued statements in the *Rule of Three* are multiplied together for a common divisor, and the other terms for a common dividend. The ordinary arithmetical books abound with examples of such operations.

The following account of the manner in which a very large transaction was actually conducted, by indirect remittances, will sufficiently illustrate the principles we have been endeavouring to explain.

In 1804, Spain was bound to pay to France a large subsidy; and, in order to do this, three distinct methods presented themselves:

1. To send dollars to Paris by land.
2. To remit bills of exchange directly to Paris.
3. To authorise Paris to draw directly on Spain.

The first of these methods was tried; but it was found too slow and expensive; and the second and third plans were considered likely to turn the exchange against Spain. The following method by the indirect, or circular exchange was, therefore, adopted:

A merchant, or *banquier*, at Paris, was appointed to manage the operation, which he thus conducted; He chose London, Amsterdam, Hamburgh, Cadiz, Madrid, and Paris, as the principal hinges on which the operation was to turn; and he engaged correspondents in each of these cities to support the circulation. Madrid and Cadiz were the places in Spain from whence remittances were to be made; and dollars were, of course, to be sent to where they bore the highest price, for which bills were to be procured on Paris, or on any other places that might be deemed more advantageous.

The principle being thus established, it only remained to regulate the extent of the operation, so as not to issue too much paper on Spain, and to give the circulation as much support as possible from real business. With this view, London was chosen as a place to which the operation might be chiefly directed, as the price of dollars was then high in England, a circumstance which rendered the proportional exchange advantageous to Spain.

The business was commenced at Paris, where the negociation of drafts issued on Hamburgh and Amsterdam served to answer the immediate demands of the state; and orders were transmitted to these places to draw for the reimbursements on London, Madrid, or Cadiz, according as the course of exchange was most favourable. The proceedings were all conducted with judgment, and attended with complete success. At the commencement of the operation, the course of exchange of Cadiz on London was 36d.; but, by the plan adopted, Spain got $39\frac{1}{4}$d., or above 8 *per cent.* by the remittance of dollars to London, and considerable advantages were also gained by the circulation of bills through the several places on the Continent. *

Usance Days of Grace.

Bills of exchange are either made payable at *sight*;—at a certain specified time *after sight*, or *after date*;—or at *usance*, which is the usual term allowed by the custom or law of the place where the bill is payable. Generally, however, a few days are allowed for payment beyond the term when the bill becomes due, which are denominated *days of grace*, and which vary in different countries. In Great Britain and Ireland, *three* days of grace are allowed for all bills except those payable at sight, which must be paid as soon as presented.

The following is a statement of the *usance* and

* Kelly's *Cambist*, Vol. II. p. 168; Dubost's *Elements of Commerce*, 2d edit. p. 218.

History of Bills of Exchange.

days of grace for bills drawn by London on some of the principal commercial cities:

[*m*|*d*. *m*|*s*. *d*|*d*. *d*|*s*. *d*|*a*. respectively denote *months after date, months after sight, days after date, days after sight, days after acceptance.*]

London on	Usance.	Days of Grace.	London on	Usance.	Days of Grace.
Amsterdam	1 m|d.	6	Gibraltar	2 m|s.	14
Rotterdam	1 m|d.	6	Leghorn	3 m|d.	0
Antwerp	1 m|d.	6	Leipsic	14 d|a.	0
Hamburgh	1 m|d.	12	Genoa	3 m|d.	30
Altona	1 m|d.	12	Venice	3 m|d.	6
Dantzic	14 d|a.	10	Vienna †	14 d|a.	3
Paris *	30 d|d.	10	Malta	30 d|d.	13
Bourdeaux	30 d|d.	10	Naples	3 m|d.	3
Bremen	1 m|d.	8	Palermo	3 m|d.	0
Barcelona	60 d|d.	14	Lisbon	30 d|s.	6
Geneva	30 d|d.	5	Oporto	30 d|s.	6
Madrid	2 m|s.	14	Rio Janeiro	30 d|d.	6
Cadiz	60 d|d.	6	Dublin	21 d|s.	3
Bilboa	2 m|d.	14	Cork	21 d|s.	3

In the dating of bills the new style is now used in every country in Europe, with the exception of Russia.

In London, bills of exchange are bought and sold by brokers, who go round to the principal merchants and discover whether they are buyers or sellers of bills. A few of the brokers of most influence, after ascertaining the state of the relative supply and demand for bills suggest a price at which the greater part of the transactions of the day are settled, with such deviations as particular bills from their being in very high or low credit, may be subject to. The price fixed by the brokers is that which is published in Wettenhall's list; but, it is stated by Mr Goldsmid, that the first houses generally negociate their bills on ½, 1, 1½ and 2 *per cent.* better terms than those quoted. In London and other great commercial cities, a class of middlemen speculate largely on the rise and fall of the exchange, buying bills when they expect a rise, and selling them when a fall is anticipated.

History and Advantages of Bills of Exchange.

History and advantages of Bills of Exchange.

It is not easy to discover the precise era when bills of exchange were first employed to transfer and adjust the mutual claims and obligations of merchants. Their invention has been ascribed to the Arabians and the Jews of the middle ages; but it seems certain that bills were in use in remote antiquity. Isocrates states that a stranger who had brought some cargoes of corn to Athens, furnished a merchant of the name of Stratocles with an order, or bill of exchange, on a town on the Pontus Euxinus, where money was owing to him; and, because the person who had drawn the bill had no *fixed domicile*, Stratocles was to have recourse on a merchant in Athens, in the event of its being protested. The merchant, says Isocrates, who procured this order found it extremely advantageous, inasmuch as it enabled him to avoid risking his fortune on seas covered with pirates and the hostile squadrons of the Lacedemonians. (De Pauw, *Recherches sur les Grecs*, I. 258.)

History of Bills of Exchange.

There is also unquestionable evidence to show, that the method of transferring and cancelling the debts of parties, residing at a distance, by means of letters of credit, or, which is the same thing in effect, by means of bills of exchange, was not unknown to the Romans. Cicero, in one of his epistles to Atticus (*Epist. ad Atticum*, XII. 24), inquires whether his son must carry cash to defray the expence of his studies along with him to Athens, or whether he might not save this trouble and expence *by obtaining an assignment for an equivalent sum from a creditor in Rome on his debtor there.* It is evident, from a subsequent epistle of Cicero's, that the latter method had been preferred, and that the transference of the money had in consequence been rendered unnecessary. (*Epist. ad Atticum*, XII. 27.) ‡

Mr Macpherson states (*Annals of Commerce*, I. p. 405,) that the first mention of bills of exchange in modern history, occurs in 1255. The Pope having quarrelled with Manfred King of Sicily, engaged, on Henry III. of England agreeing to indemnify him for the expence, to depose Manfred and raise his second son Edmund to the Sicilian throne. The enterprise misgave. But the merchants of Sienna and Florence who had originally advanced the money to carry it into effect, or rather to gratify the Pope's rapacity, were repaid by bills of exchange drawn on the *Prelates* of England; who, although they protested they knew nothing at all about the transaction, were nevertheless compelled, under pain of excommunication, to pay the bills and *interest!*

Capmany, in his *Memoirs* respecting the Commerce, &c. of Barcelona, gives a copy of an ordonnance of the magistracy, dated in 1394, enacting that bills should be accepted within twenty-four hours after their presentation;—a sufficient proof that they were in general use in the beginning of the fourteenth century.

But whatever may have been the era of the introduction of bills of exchange, it is certain that very few inventions have redounded more to the general advantage. Without this simple and ingenious contrivance, commerce could never have made any considerable progress. Had there been no means of settling and adjusting the mutual claims of debtors and creditors otherwise than by the intervention of

* In France no days of grace are allowed on bills payable *à vue*.

† In Austria, bills payable at sight, or on demand, or at less than seven days after sight or date, are not allowed any days of grace.

‡ "De Cicerone, ut scribus, ita faciam: ipsi permittam de tempore: nummorum quantum opus erit ut *permutetur* tu videbis." In his notes on a parallel passage, Grævius remarks, *Permutatio* est quod nunc barbare *cambium* dicitur.—(*Epist. ad Atticum*, XI. 24.)

History of Bills of Exchange.

metallic money, for bank paper is only another species of bills of exchange, a very great proportion,—many hundreds of millions,—of that capital which is now setting productive labour in motion in every quarter of the globe, and ministering to the comforts, the wants, and the enjoyments of mankind, must have been entirely devoted to the expediting those exchanges which are much better effected by the agency of a few quires of paper. Instead of a perpetual importation and exportation of gold and silver, necessarily attended by an immensity of trouble and expence, a few bills of exchange possessed of almost no intrinsic worth, and which may be transferred with the utmost facility, suffice to balance and adjust the most extensive and complicated transactions. But the mere setting free of an immense reproductive power, which must otherwise have been engaged in a comparatively disadvantageous employment, is only one of the many benefits which, in a commercial point of view, we owe to the use of bills of exchange. By cheapening the instruments with which commerce is carried on, they have materially reduced the price of almost every commodity; and have, in consequence, increased the command of all classes over the necessaries and luxuries of life, and accelerated the progress of civilization, by occasioning a much more extensive intercourse, and intimate connection between different and independent countries than could otherwise have taken place.

In a political point of view, their effects have been equally salutary. They have enabled every individual imperceptibly to transfer his fortune to other countries, and to preserve it safe alike from the rapacity of his own government, and the hostile attacks of others. The security of property has in this way been prodigiously augmented. And although we should concede to the satirist, that paper credit has "lent corruption lighter wings to fly," * it is easy to show that it has powerfully contributed to render subjects less dependent on the policy, and less liable to be injuriously affected by the injudicious and impolitic measures of their rulers. In countries in a low stage of civilization, the inhabitants endeavour, by burying all the gold and silver they can collect, to preserve a part of their property from falling a prey to the extortion of the despots by whom they are alternately plundered and oppressed. This was universally the case in the middle ages; and in Turkey, China, and other Eastern countries, the practice is still carried on to a very great extent. Some political economists have endeavoured to account for the constant importation, and high value of the precious metals in India, from the loss which necessarily attends the practice of hoarding; and undoubtedly this locking up of capital is one of the main causes of the extreme poverty of these countries. But the security derived from bills of exchange is infinitely greater than any that can possibly be derived from the barbarous expedient of trusting property to the bosom of the earth. "Pregnant with thousands flits the *scrap* unseen," and in a moment places the largest fortune beyond the reach of danger! Mr Harris was, therefore, right in stating, "that the introduction of bills of exchange was the greatest security to merchants, both as to their persons and effects, and consequently the greatest encouragement to commerce, and the greatest blow to despotism, of any thing that ever was invented."—(*Harris on Coins*, Part I. p. 108.)

Law of Bills of Exchange.

Previous to the peace of Paris in 1763, Amsterdam, because of its commerce, the wealth and punctuality of its merchants, and their intimate connection with all the other great trading cities of the world, was the chief place where the accounts of the different commercial countries were balanced and adjusted. But the entire loss of foreign trade, and the other vexations to which Holland was subjected during the ascendancy of the French, has nearly divested Amsterdam of all share in this business. London has now become the trading metropolis of Europe, and of the world. The vast extent of its commercial dealings has necessarily rendered it the great mart for bills of exchange. Its bill merchants, a class of men remarkable for their shrewdness, and generally possessed of large capitals, assist in trimming and adjusting the balance of debt and credit between the most remote countries. They buy up bills where they are cheap, and sell them where they are dear. And, in consequence of the extent of their correspondence, and the magnitude of their transactions, have given a steadiness to the exchange, to which it could not otherwise have attained.

Laws and Customs respecting Bills and Notes.

Law respecting Bills, &c.

A Bill of Exchange may be defined to be an open letter of request or order from one person, the *drawer*, to another person, the *drawee*, who is thereby desired to pay a sum of money, therein specified, to a third person, the *payee*. When the *drawee* obeys the request or order, by subscribing the document,

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* "Blest paper credit! last and best supply!
That lends corruption lighter wings to fly!
Gold imp'd by thee can compass hardest things,
Can pocket states, can fetch or carry kings;
A single leaf shall waft an army o'er,
Or ship of senates to some distant shore;
A leaf, like Sibyll's, scatter to and fro
Our fates and fortunes, as the wind shall blow:
Pregnant with thousands flits the scrap unseen,
And silent sells a king, or buys a queen." Pope.

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he becomes *acceptor*. If the contrary do not appear on the face of the bill, it is presumed that the *drawee* has funds of the *drawer's* in his hands to the amount of the bill, and that the drawer is indebted to the *payee* to that extent. The bill thus operates as a transfer, or mercantile assignment to the payee, of the drawee's debt to the drawer. But a bill may also be drawn payable to the *drawer* or his order, in which case, when accepted, the document is not an assignment, but merely the acknowledgment or constitution of a debt. This is also accomplishable by *promissory-note*, which is a promise by one person, the *maker* (Scoticé *Granter*), to pay a certain sum to another person, the *payee* (Scoticé *Grantee*.) The bill and the promissory-note have now equally the privilege of being *assignable*, or *transferable* from one person to another by indorsement, that is, by the *payee* subscribing his name on the back of the document. In this case the *payee* becomes an *indorser*, and the person in whose favour the indorsement is made is called the *indorsee*, who may again indorse to another; and in this manner the bill or note may pass from hand to hand without limitation. Each indorsation may be made *in full* or *in blank*; in full, by filling up the name and description of the party in whose favour it is made, which is attended with several advantages if the document should be lost or stolen; in blank, by merely subscribing the indorser's name, which is equivalent to making it payable to the *bearer*. All the indorsements, or any one of them, may also be *qualified* by the words *without recourse*, and when this is done, neither the indorsee nor any subsequent *holder* of the bill or note can have recourse on the indorser who thus qualifies his indorsation. If none of the indorsations be so qualified, the *last holder* for value and *in bona fide*, has all the prior indorsers and other parties to the bill or note bound to him jointly and severally. He may select any one of them, or proceed against them all at the same time; and if all were to become bankrupt, he could claim on the estate of each for the whole debt, and be entitled to receive dividends from all the estates until he obtained *full payment*, but which he must not exceed. An indorser may also qualify his indorsation by the condition that his indorsee shall not have the power of making an indorsement from himself.

From the negociability thus conferred upon them, bills have been compared to bags of money; but it should be remembered that, in the former case, we transfer only *a right*; in the latter, the *property itself*. The comparison is best supported in those transferences which are made without recourse, since, in those instances, the bill passes from hand to hand without any alteration in the rights and duties of those interested in it, and without any one acquiring an additional security. In the simplest case, however, the rights arising on a bill may be preserved or lost by the conduct of the holder, and where there has been even one unqualified indorsation, the duties of the holder are of a delicate and important nature. But these will be more readily understood after we have pointed out the requisites of a bill.

Requisites of a Bill or Note.

The general requisites of a bill are, that it must be payable at all events; that it must be for payment of money only; and that the money must not be payable from any particular fund. Of the more special requisites the *first* is, that any bill or note drawn or made in Great Britain (though dated abroad *) or in its colonies, is, that it be written on paper *stamped* according to the law of the mother country or colony, as it happens to be drawn in the one or the other. The stamp-duty varies according to the sum in the bill, and the extension of the term of payment; but for these particulars, and the mode of complying with the provisions of the law, reference should be made to the statutes in force at the time. The present regulating statute is that of the 55th Geo. III. c. 184, both as to *inland* bills and notes, and bills of exchange drawn here *on* foreign countries. As to bills truly drawn in foreign states, not colonies of Great Britain, on traders in this country, our law takes no cognizance of them as to whether they are or are not stamped; but *promissory-notes* made *out* of Britain are declared *not* to be negociable or payable unless stamped agreeably to our laws. Bills drawn at home must also be written on the stamp appropriated for bills. If on a stamp of another denomination, though of equal or superior value, they are invalid if not got re-stamped, which they may be for payment of the duty and a penalty of 40s. when carried to the stamp-office before they are due, but when after due, the penalty is L. 10. If written on a stamp below the proper value, a penalty is incurred of L. 50, and the bills besides are *null* (Bell's *Com. on Bankrupt Law*, Vol. II. p. 249); but it has been found with us in England, that if a bill is *not* properly stamped, a neglect to present for acceptance or payment will not relieve parties who were *otherwise* liable in the *original debt* in respect of which the bill was granted. The relief, in this case, is granted by a court of equity, but which relief is not extended to remote indorsers, not responsible for the original debt. Relief, however, is given when a party has bound himself to grant a valid note or bill, but gives one by mistake or design on a defective stamp. Negociable bills under L. 5 must, by 37th Geo. III. c. 32, be payable within twenty-one days, and bear the name of the *place* where they are made, without which also *checks* on bankers are liable to stamp-duty. Penalties are likewise imposed on the post-dating of such *checks*, or of bills for the purpose of reducing the duty by apparently shortening the term of payment; and there are provisions in those laws respecting bills drawn in sets or otherwise, with which every trader should make himself acquainted. This, however, it is very difficult to do in all its bearings; since the penalties and provisions of the prior statutes are retained in every subsequent one, except as therein specially altered. This is one great evil in

* Chitty, 5th edit. p. 70, 7 T. R. 601. 4 Camp. *Law*, 269.

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our fiscal regulations. Where the law cannot be known, transactions are rendered uncertain, property insecure, and litigation is increased to a mischievous extent. But the worst evil is, that this state of the law increases in a prodigious degree the influence of the crown, by the power over traders which is thus placed in the hands of solicitors of stamps, excise, customs, and other crown officers.

The other requisites of a bill are, 2*dly*, That it should bear the name of the place at which it is made or drawn; and if the street and number of the house be added, it is easier to give and receive the notices that may be necessary in proper time. 3*dly*, The *date* should be distinctly marked, and, if *written* at length, a higher protection would be afforded against accidental or intentional alterations and vitiations. If a bill have no date, the date of issuing will be held as the date of the bill. 4*thly*, The time of payment should be clearly expressed; and a *time certain* is necessary to make the document *negociable;* that is to say, the payment must not depend on an event that can never happen, such as the *marriage of a person*, though it may on the *death*. 5*thly*, The *place* at which a bill is made payable should also, for the sake of safe negociation, be distinctly stated; because at that place *presentment* must be made both for acceptance and payment. If no place be mentioned, the place of doing business, if the acceptor have one, or, otherwise, his dwelling-house becomes the place of presentment. 6*thly*, The sum payable should be clearly written in the body of the bill, and the superscription of the sum in figures will aid an omission in the body. This sum must in all cases be above 20s.; and if payable more than twenty-one days after date it must exceed L. 5. 7*thly*, It should contain an order or request to pay. 8*thly*, Of bills drawn in parts or sets, each part or copy should mention the number of copies used, and be made payable on condition that none of the others has been paid. The *forgery* of an indorsement on one of the parts passes no interest even to a *bona fide* holder, and will not prevent the payee from recovering on the other part. 9*thly*, Every bill should specify distinctly *to whom* the contents are to be paid; but a *bona fide* holder, or his executor, may fill up a blank, if one be left, for the name of the payee, and recover payment. (Chitty, 82; Bell, Vol. II. p. 251, &c.) 10*thly*, If it be intended that a bill is to be negociable, it should contain the operative words of transfer "to order;" although, if the original intention be clear, these words may be inserted without a fresh stamp. (Chitty, 86.) 11*thly*, It is advisable in all cases to insert *value received;* since, without these words, the holder of an *inland* bill for upwards of L. 20 could not, in England, recover interest and damages against the drawer and indorser in default of acceptance or payment. Bills bearing for value received, and payable *after date*, seem also to possess advantages when lost, under the stat. 9th and 10th W. III. c. 17; but equity would probably extend these to indorsements; and 3d and 4th Anne, c. 9, it is thought extends the same to notes. (Chitty, p. 196.) 12*thly*, As to foreign bills, the drawee should attend to whether they are to be paid *with* or *without farther advice;* since the propriety of his accepting or paying will, in the one case, depend on his having received advice. The more carefully all these requisites are attended to, the greater is the security of all concerned against accidents and litigation. But traders, we fear, have too generally a prejudice in favour of that brevity which approaches to looseness of expression, and against that precision which alone can keep them out of difficulties.

General explanatory Rules and Usages.

When a bill, check, or note, is payable *on demand*, or when *no time of payment is expressed*, it should be presented within a reasonable time after receipt, and is payable *on presentment*, without the allowance of any days of grace. It is yet *unsettled* (Chitty, 344, *et seq.*) whether bills drawn *at sight* are entitled to days of grace, though the weight of authority is rather in favour of them. If drawn at one or more days after sight, the days of grace must be allowed. The day on which a bill is dated is not reckoned one; but all bills having days of grace, become due, and must be presented and protested *on the third day*, and if that day be a Sunday or holiday, on the *second*. The rule for giving notice of non-acceptance or non-payment is different, since, if the day on which it should have been given be a day of rest, by the religion of the party, such as the Jews' Sabbath, the notices will be good if given on the next day. Calendar months are always understood with respect to bills; and if dated on the 29th, 30th, or 31st of January, payable *one month* after date, they will fall due on the *last day* of February, from which the days of grace are to be calculated. Presentments of bills should be made within business hours. These are generally considered to be in London from nine morning to six evening, but a protest has been held good against an ordinary trader when made at eight. This would not have been good in the case of bankers, whose hours (from nine to five in London) must be attended to. In Edinburgh, bankers' hours are from ten to three; traders' from ten to three, and from six to eight; but there are no Scotch decisions holding these as the only business hours. A verbal notice of the dishonour of an *inland* bill is good; but as such notice is always matter of parole evidence, it is better in every case to give notice in writing; and the regular mode of doing so is by post. Such notice, if put into the general post-office, or an authorized receiving-house, is good though it miscarry, provided the letter be regularly booked, and reasonable proof be made of its having been put into the post-office. If given only to a bellman in the street, it would not in such a case be good. When there is no post the ordinary mode of conveyance, such as the *first* ship or carrier, is sufficient. As to *foreign bills*, notices of dishonour, with the respective protests, must be despatched by post on the day when the bills become due, or on which acceptance was refused, if any post or ordinary conveyance set out that day, and if not, by the next earliest conveyance. (Chitty, 291.) As to *inland* bills, notice should be made by the first post after the expiry of the day, when the parties reside at a distance; if in the same town, it is enough if the notice be made so as to be received within business hours of the following day; and this may

Business hours.

Rules of giving Notices.

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be done by the twopenny or penny post, if receivable within the time mentioned. When a holder deposits his bill at his banker's, the number of persons entitled to notice is increased by one; and each party in succession is entitled to *twenty-four hours* for giving notice. (6 East 3. Bell, 263.) Such notice, as to inland bills, is necessary in England for preserving recourse as to the principal sum only. If protest be made and notice given within fourteen days, the recourse is preserved as to *interest*, damages, and expences. In Scotland a protest is necessary in every case; and there is no distinction made as to the mode of recourse between principal and interest; but intimation to the drawer within *fourteen* days preserves recourse for the whole (Bell, Vol. II. p. 265); and it has been decided, that notice to an indorser may be good even after the fourteen days, if there has been no unnecessary delay, (*Fac. Col.* 2d June 1812.) But this applies only to *inland* bills, and a bill drawn from Scotland upon England is in Scotland held to be foreign. (Bell. Vol. II. p. 265.) Every bill should be presented for payment on the day upon which it falls due, unless that be rendered impossible by some unforeseen and *inevitable* accident, such as shipwreck, or sudden illness, or death. To preserve recourse, the accident, and the presentment of the bill as soon as possible afterwards, must be intimated without delay, and, if denied, proved by the party who seeks recourse. The same doctrine will hold as to presentments for non-acceptance, and notices of dishonour. But the loss or destruction of a bill is no excuse for not demanding payment and protesting; the protest in that case being made upon a copy or statement of the bill, if the party who has right to hold the bill has it in his power to make such a statement. If the destruction of the bill can be proved, action will be sustained in a court of law; if not, the redress is got upon giving an indemnity in a court of equity; but as equity will not interfere where law can, it is of importance in such a case, and indeed in all cases of difficulty, to resort at once to the best professional advice. Inconsiderate attempts to remedy neglects, or cure what is defective, generally make the case worse, and often implicate character. Cases of great hardship and difficulty frequently arose on bills granted partly for *usurious* consideration. A mighty benefit, however, has now been conferred by the statute 58th Geo. III. c. 93, which enacts, "That *no bill* of exchange or promissory-note that shall be drawn or made after the passing of this act shall, though it may have been given for a usurious consideration, or upon a usurious contract, *be void* in *the hands of an indorsee for valuable consideration*, unless such an indorsee had, at the time of discounting or paying such consideration for the same, *actual notice* that such bill, &c. had been originally given for a usurious consideration, or upon a usurious contract." It is much to be regretted, that the same protection was not extended by this statute to the *innocent holder* of a bill granted for a game debt. Such bills are still void in the hands of a *bona fide* indorsee. In Scotland, it has been decided otherwise. (25th January 1740, Nielson; Bell, Vol. II. p. 210.) The rage for legislation has not yet extended itself to lawyers, who, as a body, can hardly be expected to display an anxiety to remedy defects which add to their emoluments and consequence. How much of the learning of this profession is wasted on niceties and difficulties that would readily yield to the spell of an act of Parliament! To the law, however, we owe this sound maxim, that, "unless it has been so expressly declared by the legislature, as it formerly was in the case of usury, and still is as to bills for *game* debts, illegality of consideration will be no defence in an action at the suit of a *bona fide* holder, without notice of the illegality, unless he obtained the bill after it became due." (Chitty, 105.) Thus *forgery* does not vitiate a bill. The forged document is good to and against all parties, but those whose names are forged. Against one whose name is forged, it is true, it will neither support an action nor ground a claim; "yet if he have given credit to acceptances or indorsations as binding on him, forged by the same hand, he will be liable." (3 Esp. N. P. 60. 2 Bell, 250.) Subsequent approbation also does away an objection on the head of forgery or fraud, and generally all sorts of objections otherwise competent. This doctrine holds as to vitiations when the stamp laws are not concerned; but without the consent of parties all vitiations or alterations of bills in material parts are fatal. (2 Bell, 252.) A clerk or servant may accept a bill for his master if authorized so to do; and authority will be inferred from a sanctioned practice. The law on this point is dangerous, and would require legislative revision. If the servant or agent do not explain the character in which he acts, but subscribes his own name simply, he will bind himself, not his employer. An acceptor may enlarge the term of payment, or accept for a part, or under any other condition not expressed in the bill; but in that case it is optional in the holder to take the acceptance as thus offered, or to proceed as if no such offer had been made; if rejected, the protest should bear the condition, and the rejection of it; it should also be kept in view, that a *holder* who accepts of a limited or conditional acceptance, liberates the drawer and prior indorser, unless he have their consent. Blank indorsements are held to be of the date of the bill until the contrary is proved. Indorsements after the term of payment, though for value, do not protect the indorsees like indorsements before maturity; very slight evidence is admitted as proof of knowledge of dishonour, and the holder in that case becomes liable to all exceptions which can be stated against the right of his immediate indorser, or the person who held the bill when it became due. When acceptance is refused, and the bill returned with protest, action may be raised immediately against the drawer, though the regular time of payment is not arrived. His debt, in such a case, is considered as contracted the moment the bill was drawn; if the date of the bill be prior to that of a commission of bankrupt, the debt, in such a case, may be claimed upon. As to current bills, and contingent claims, the case is unfortunately different; in these respects England might derive great help from the law of Scotland.

Effect of inevitable Accident. How to act when Bill lost. Effect of Usury. Effect of Gaming. Effect of Forgery. Effect of Vitiation. Acceptance by Procuration. Conditional Acceptance. Indorsements.

Duties of Drawee.

The *drawee*, who, having funds, refuses to accept, is responsible for the consequences to the *drawer*,

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and may also be sued for payment by the payee or holder, the presentment and protesting of the bill for non-acceptance, operating as an intimated assignment and complete transfer of the debt *to the holder*, who in Scotland is preferred to any subsequent arrester. The *drawee* who has no funds is not bound to accept; but, after protest for non-acceptance, he may accept supra-protest for the *honour* of the drawer and indorsers, or either of them. A *third party* may thus accept for *honour* supra-protest; and whoever does so, if he give immediate notice, and send off the protest, may have immediate recourse on the party or parties for whose honour he has interfered.

Payee or Holder.

It is the duty of a *payee*, when directed by the drawer, and of every one who is merely an agent for the owner, though acting gratuitously, to present a bill for acceptance. The time thought reasonable for this purpose is twenty-four hours, or at least within business hours of the day following that on which the bill was received. It is prudent in all holders of a bill to present for acceptance within this period; and *in all cases* where a presentment is made, and acceptance refused, notice should be given to all against whom it is meant to preserve recourse. A draught may be left twenty-four hours with the drawee, if no post go out in the meantime; but if he intimate within that time that he will not accept, or ask *more time* to consider, *notice should be given*. (Chitty, 288, 289.) A verbal acceptance, if it can be proved, or one by a separate writing, binds the drawee; but in Scotland none but a written acceptance on the bill will authorize the usual summary diligence. (Chitty, 217–270; 2 Bell, 69–240.) If the drawee had no funds, notice to the drawer is not necessary; but as the not having funds is a matter of fact to be proved, it is safer in this, and indeed in all other cases, to give the usual and regular notice. When a bill is drawn at some certain time *after sight*, presentment is *necessary* to fix the term of payment. Respecting bills of this description, both foreign and inland, the general rule is, that *due diligence must be used*. Foreign bills, so drawn, may be put into the circulation without acceptance as long as the convenience of the successive holders requires; and it has been found not to be *laches* (in Scotland *mora*, or undue delay) to keep a bill (at three days' sight) out in the circulation for twelve months; but if, instead of circulating, a holder were to lock it up, this would be *laches*. An unaccepted inland bill may also be put into circulation, and any holder, who does not circulate it, has a reasonable time, such as the fourth day respecting a bill drawn within twenty miles of London, for presenting it there for acceptance. Despatch and attention, however, are always advisable. It is said that when a bill has been already protested for non-acceptance, and due notice thereof given, it is not necessary to protest or to give notice on account of non-payment; but it is usual to do so, and the safer practice. The same rules, and the same time, should be observed as to non-payment, that are observed as to protest and notice, in the case of non-acceptance. When inland bills are made payable on a day named and fixed in the bills, it is common to delay presenting them for acceptance, until they can also be presented for payment, and then, if necessary, to protest for both; but it is better to make a presentment for acceptance as soon as it can be done in the ordinary course of business. It has already been stated, that notice either of non-acceptance when a presentment has been made, or for non-payment, *must* be given *to all the parties* to whom the *holder* intends to resort for payment.

Effect of Bankruptcy.

Bankruptcy is no excuse for neglecting any step in the negociation of a bill. If a party be bankrupt, notice of recourse should be given to him and his assignees; if *dead*, to his executor or administrator; if abroad, the notice should be left at his place of residence, if he have one, and a demand of acceptance or payment (when that is necessary) should be made of his wife or servant. Notice should also be made to one who merely guarantees payment; and a person who subscribes a bill not addressed to him, is held to be a collateral security. If notice be made to one indorser, he may give notice to prior indorsers, or to the drawer; and if done timeously, it will be available to the holder; but notice by a party, not party to the bill, nor agent for a party, will not be available.

Accommodation Paper.

Accommodation-bills are subject to the same rules as other paper, except among those who agree to lend their names or credit. Among them, the rule is, that he for whose use the money is to be raised shall provide for the bill; but as all the others have an action of relief when forced to pay, they are entitled to notice. In Scotland this has been extended to the drawer when he is not the party for whom the credit was intended.

Cross-Paper.

With respect to cross-paper, it is held that mutual accommodations exchanged are good considerations for each other; that in case of bankruptcy, a dividend from any one estate is to be held as payment of all that can be demanded in respect of that debt; and that there can be no double ranking of the same debt. But questions often arise in such cases which require the utmost professional skill to comprehend and decide. In a short digest of this nature it is impossible to enter into the niceties of legal questions; and we can only observe generally, that parties should never act in cases of difficulty, without taking the best professional assistance.

The law respecting bills of exchange is less offensive to reason than almost any other branch of our law, since, where the law is silent here, recourse is had to the custom of merchants. Still there are many points which might easily be improved, if lawyers would set heartily about the work. Lawyers, however, are seldom innovators, though the innovations required be only for the better; and very few others are able to legislate in matters of jurisprudence.

The best authorities respecting the law of bills are the treatises of *Chitty* and of *Bayley* as to English law, and Mr Bell's valuable *Commentaries on Mercantile Jurisprudence*, as to Scotch law.

(S. S.)

Tables.

TABLES RELATIVE TO THE EXCHANGE BETWEEN GREAT BRITAIN AND OTHER COUNTRIES.

I. ACCOUNT of the market prices of STANDARD GOLD AND SILVER BULLION, showing their relative proportions to each other;—the *real par* and course of exchange between London and Hamburgh, and the *per centage* in favour of and against London;—the *per centage* above and below the mint price of gold;—and the number of Bank of England notes in circulation from 1760 to 1819.*

		Price of Standard Gold *per* oz.			Price of Standard Silver *per* oz.			Their relative proportions to each other.	Par of Exchange with Hambro.		Course of exchange with Hambro.		*Per cent.* in favour of London.	*Per cent.* against London.	*Per centage* above the Mint price of Gold.			*Per centage* below the Mint price of Gold.			Bank of England Notes in Circulation.
		L.	*s.*	*d.*	*L.*	*s.*	*d.*		*sch.*	*gr.*					*L.*	*s.*	*d.*	*L.*	*s.*	*d.*	
1760	Jan. 1	3	18	6	0	5	6½	14.16 to 1	32	9.9	36	4	10.6		0	16	0½				
	May 2	3	19	1	0	5	6	14.37 1	33	3.7	35	6	6.5		1	11	0¼				
	Sept. 2	4	0	1	0	5	7¼	14.45 1	33	6.0	32	2		4	2	16	8½				
1	Jan. 2	3	18	10	0	5	8½	13.81 1	32	0.1	32	0		0.1	1	4	7¼				
	May 1	4	0	0	0	5	9½	13.81 1	32	0.1	32	2	0.4		2	14	6¾				6,001,810
	Sept. 1	4	0	6	0	5	7⅝	14.27 1	33	0.9	32	5		2	3	7	5				
2	Jan. 1	3	19	0	0	5	6¼	14.30 1	33	1.8	32	11		2.0	1	8	10½				
	May 4	3	19	3	0	5	7½	14.09 1	32	7.9	34	3	4.8		1	15	3¾				6,131,770
	Sept. 3	3	19	4	0	5	5	14.64 1	33	11.2	35	0	3.6		1	17	5¼				
3	Jan. 4	4	0	0	0	5	5¾	14.60 1	33	10.1	34	2	0.9		2	14	6¾				
	May 3	4	1	3	0	5	8	14.33 1	33	2.6	34	2	2.7		4	6	8				6,889,680
	Sept. 2	4	1	6	0	5	6	14.81 1	34	4.0	34	7	0.7		4	13	1¾				
4	Jan. 3	3	18	3	0	5	4½	14.55 1	33	8.7	34	5	1.9		0	9	7½				
	May 1	3	18	3	0	5	3½	14.78 1	34	3.1	34	11	1.1		0	9	7½				
	Sept. 4	3	18	0	0	5	3½	14.74 1	34	2.0	35	0	2.4		0	3	2½				
5	Jan. 1	3	18	0	0	5	3½	14.74 1	34	2.0	35	1	2.6		0	3	2¼				
	May 3	3	18	0	0	5	4¼	14.56 1	33	9.0	34	11	3.4		0	3	2½				
	Sept. 3	3	18	8	0	5	5	14.52 1	33	7.9	34	4	2.0		1	0	3¾				
6	Jan. 3	3	18	7	0	5	5¾	14.34 1	33	2.9	34	6	3.7		0	18	2¼				
	May 2	3	19	2	0	5	6½	14.28 1	33	1.2	34	11	5.4		1	13	2				
	Sept. 2	3	19	0	0	5	7	14.15 1	32	9.6	35	3	8.2		1	8	10½				
7	Jan. 2	3	19	3	0	5	7¼	14.14 1	32	9.3	35	6	8.3		1	15	3¾				
	May 1	3	19	10	0	5	7½	14.19 1	32	10.7	35	10	8.9		2	10	3½				
	Sept. 1	3	19	5	0	5	6½	14.33 1	33	2.6	35	11	8.1		1	19	7				
8	Jan. 1	3	18	8	0	5	5½	14.41 1	33	4.8	34	11	4.4		1	0	3¾				
	May 3	3	19	1	0	5	6½	14.27 1	33	0.9	34	8	4.8		1	11	0¼				
	Sept. 2	3	19	6	0	5	6¼	14.40 1	33	4 6	34	5	3.0		2	1	8¾				
9	Jan. 3	3	19	7	0	5	7	14.37 1	33	3.7	33	2		0.5	2	3	10¼				
	May 2	4	0	3	0	5	7	14.32 1	33	2.3	33	8	1.4		3	1	0				
	Sept. 1	4	0	4	0	5	7½	14.28 1	33	1 2	33	6	1.2		3	3	1½				
1770	Jan. 2	4	0	6	0	5	7¾	14.25 1	33	0.4	33	2	0.4		3	7	5				
	May 1	4	0	4	0	5	8	14.17 1	32	10.1	33	3	1.3		3	3	1½				
	Sept. 4	4	0	0	0	5	6½	14.43 1	33	5.4	33	2		0.1	2	14	6¾				
1	Jan. 1	3	18	9	0	5	7	14.10 1	32	8.2	33	8	.5		1	2	5½				
	May 3	3	19	2	0	5	7¾	14. 2 1	32	6 0	33	6	.5		1	13	2				
	Sept. 3	4	0	8	0	5	7¼	14 39 1	33	4.3	32	11		1.4	3	11	8¼				
2	Jan. 3	4	1	0	0	5	7¾	14.34 1	33	2.9	32	7		2.0	4	0	3				
	May 1	4	0	9	0	5	8¼	14.19 1	32	10.7	32	10		0.2	3	13	10				6,201,030
	Sept. 1	3	19	0	0	5	5	14.58 1	33	9.6	33	5		1.2	1	8	10½				
3	Jan. 5	3	18	0	0	5	4½	14.51 1	33	7.5	34		1.1		0	3	2½				
	May 4	3	17	11	0	5	4	14.60 1	33	10.1	34	9	2.6		0	1	0¾				
	Sept. 3	3	17	9	0	5	3½	14.69 1	34	0.1	34	8	1.9					0	3	2½	
4	Jan. 4	3	17	9	0	5	2½	14.92 1	34	7.	34	9	0.4					0	3	2½	

* This table, with the exception of the column of Bank of England notes, from 1760 to 1809, is extracted from the second edition of Mr Mushet's pamphlet. The last ten years have been filled up from the accounts given in the *Reports on the Expediency of the Bank resuming Cash Payments*, laid before Parliament in 1819. The *fixed par* is taken at 34 schillings, 11 grotes, and ¼, which is esteemed the true *par* by the merchants, though it differs about ⅝ *per cent.* from the par (35s. 1d. Hamburgh currency), as estimated by Dr Kelly from the Mint regulations. The silver in the English pound sterling is valued throughout at 5s. 2d. an ounce. The bills on Hamburgh from the negociation of which this table has been formed, have been invariably drawn at 2½ usances.

Tables.

		Price of Standard Gold *per* oz. L. s. d.	Price of Standard Silver *per* oz. L. s. d.	Their relative Proportions to each other.	Par of Exchange with Hambro. Sch. gr.	Course of exchange with Hambro.	*Per cent.* in favour of London.	*Per cent.* against London.	*Per centage* above the Mint price of Gold. L. s. d.	*Per centage* below the Mint price of Gold. L. s. d.	Bank of England Notes in Circulation.
1774	May 3	3 17 9	0 5 3¾	14.63 to 1	33 11.	34 7	1.9			0 3 2½	
	Sept. 2	3 17 7	0 5 3	14.77 1	34 2.8	34 5	0.5			0 7 5¾	
1775	Jan. 3	3 17 7	0 5 4	14.54 1	33 8.5	34 3	1.6			0 7 5¾	
	May 2	3 17 7	0 5 5	14.32 1	33 2.3	34 4	3.4			0 7 5¾	
	Sept. 1	3 17 7	0 5 3½	14.66 1	34 0.6	34 4	0.8			0 7 5¾	
6	Jan. 5	3 17 7	0 5 4¾	14.37 1	33 3.7	34 1	4.8			0 7 5¾	
	May 3	3 17 7	0 5 6	14.10 1	32 8.2	33 8	3.			0 7 5¾	
	Sept. 3	3 17 7	0 5 5½	14.21 1	32 11.3	33 5	1.4			0 7 5¾	
7	Jan. 3	3 17 7	0 5 7½	13.79 1	31 11.6	33 2	3.7			0 7 5¾	
	May 2	3 17 7	0 5 6¾	13.91 1	32 2.9	32 10	1.8			0 7 5¾	
	Sept. 2	3 17 7	0 5 6¼	14.05 1	32 7.5	32 2	1.4			0 7 5¾	
8	Jan. 2	3 17 7	0 5 9	13.49 1	31 3.2	32 4	3.4			0 7 5¾	
	May 1	3 17 7	0 5 5½	14.21 1	32 11.3	34 2	3.7			0 7 5¾	7,540,070
	Sept. 1	3 17 7	0 5 4½	14.43 1	33 5.4	34 5	2.8			0 7 5¾	
9	Jan. 1	3 17 7	0 5 2	15.01 1	34 9.5	35 6	2.9			0 7 5¾	
	May 4	3 17 6	0 5 2½	14.88 1	34 5.9	36 2	4.8			0 9 7½	6,000,000*
	Sept. 3	3 17 6	0 5 4½	14.41 1	33 4.8	33 9	1.			0 9 7½	
1780	Jan. 4	3 17 6	0 5 3	14.76 1	34 2.5	34 6	0.8			0 9 7½	
	May 2	3 17 6	0 5 6	14.09 1	32 7.9	35 2	7.6			0 0 7½	8,400,000*
	Sept. 1	3 17 6	0 5 5¼	14.25 1	33 0.4	34 1	3.2			0 9 7½	
1	Jan. 2	3 17 6	0 5 5½	14.19 1	32 10.7	34 1	3.6			0 9 7½	
	May 1	3 17 6	0 5 7½	13.77 1	31 11	33 7	5.2			0 9 7½	
	Sept. 4	3 17 6	0 5 8½	13.57 1	31 5.5	32 2	2.2			0 9 7½	
2	Jan. 1	3 17 6	0 5 9½	13.38 1	31 0.2	31 9	2.3			0 9 7½	
	May 3	3 17 6	0 5 10¾	13.14 1	30 4.7	32 11	8.3			0 9 7½	8,000,000*
	Sept. 3	3 17 9	0 5 9½	13.42 1	31 1.3	32 6	4.4			0 3 2½	
3	Jan. 3	3 17 9	0 5 8	13.72 1	31 9.6	32 7	2.4			0 3 2½	
	May 2	3 18 0	0 5 10¼	13.32 1	30 10.5	31 9	2.8		0 3 2½		6,707,540
	Sept. 2	3 18 0	0 5 8½	13.66 1	31 7.9	31 6		0.5	0 3 2½		
4	Jan. 2	3 18 0	0 5 5½	14.29 1	33 1.5	33 6	1.1		0 3 2½		
	May 4	3 17 10½	0 5 3¼	14.77 1	34 2.8	34 4	0.2				6,392,730
	Sept. 3	3 17 10½	0 5 3¼	14.77 1	34 2 8	34 7	1.0				
5	Jan. 7	3 17 10½	0 5 2¾	14.89 1	34 6.2	35 0	1.4				
	May 3	3 17 10½	0 5 2½	14.95 1	34 7.9	34 11	0.7				
	Sept. 2	3 17 6	0 5 1½	15.12 1	35 0.6	35 4				0 9 7½	
6	Jan. 3	3 17 6	0 5 2¾	14.82 1	34 4.2	34 10	1.1			0 9 7½	
	May 2	3 17 6	0 5 3½	14.64 1	33 11.2	34 5	1.4			0 9 7½	
	Sept. 1	3 17 6	0 5 3	14.76 1	34 2.5	34 3	0.1			0 9 7½	
7	Jan. 2	3 17 6	0 5 2¾	14.89 1	34 6.2	34 5		0.1		0 9 7½	
	May 1	3 17 6	0 5 3¼	14.70 1	34 0.9	34 7	4.0			0 9 7½	8,688,000‡
	Sept. 4	3 17 6	0 5 3¾	14.58 1	33 9.6	35 0	3.5			0 9 7½	
8	Jan. 1	3 17 6	0 5 3¾	14.58 1	33 9.6	35 1	3.8			0 9 7½	
	May 2	3 17 6	0 5 3¾	14.58 1	33 9.6	35 4	4.5			0 9 7½	
	Sept. 2	3 17 6	0 5 3¾	14.58 1	33 9.6	35 0	3.5			0 9 7½	
9	Jan. 6	3 17 6	0 5 3¾	14.58 1	33 9.6	34 10	3.0			0 9 7½	
	May 1	3 17 6	0 5 3¼	14.70 1	34 0.9	35 6	4.1			0 9 7½	
	Sept. 1	3 17 6	0 5 2¾	14.89 1	34 6.2	35 5	2.6			0 9 7½	
1790	Jan. 29	3 17 6	0 5 2½	14.88 1	34 5.9	35	1.4			0 9 7½	
	May 4	3 17 6	0 5 3¼	14.70 1	34 0.9	35 4	3.7			0 9 7½	
	Sept. 3	3 17 6	0 5 2½	14.88 1	34 5.9	35 6	2.9			0 9 7½	
1	Jan. 4	3 17 6	0 5 3	14.76 1	34 2.5	35 6	3.7			0 9 7½	
	May 3	3 17 6	0 5 3¼	14.70 1	34 0.9	35 11	5.4			0 9 7½	10,689,510
	Sept. 2	3 17 6	0 5 2¼	14.94 1	34 7.6	35 6	2.5			0 9 7½	
2	Jan. 3	3 17 6	0 5 4	14.53 1	33 8.2	34 6	2.4			0 9 7½	
	May 1	3 17 6	0 5 5¼	14.25 1	33 0.4	34 3	3.7			0 9 7½	11,102,855†
	Sept. 4	3 17 6	0 5 5	14.30 1	33 1.8	34 0	2.5			0 9 7½	

* Lords' *Report on the Bank's resuming Cash Payments*, 1819, p. 75.
‡ Amount in circulation on 25th February.
† Average of January and July.

Tables.

Year	Date	Price of Standard Gold *per* oz. L. s. d.	Price of Standard Silver *per* oz. L. s. d.	Their relative Proportions to each other.	Par of Exchange with Hambro. Sch. gr.	Course of exchange with Hambro.	*Per cent* in favour of London.	*Per cent.* against London.	*Per centage* above the Mint price of Gold. L. s. d.	*Per centage* below the Mint price of Gold. L. s. d.	Bank of England Notes in Circulation.
1793	Jan. 1	3 17 6	0 5 4¾	14.36 to 1	33 3.4	35 4	6.1			0 9 7½	
	May 3	3 17 6	0 5 2½	14.88 1	34 5.9	37 6	8.7			0 9 7½	11,928,101*
	Sept. 3	3 17 6	0 5 1½	15.12 1	35 0.6	36 0	2.7			0 9 7½	
4	Jan. 3	3 17 6	0 5 1½	15.12 1	35 0 6	35 9	2.0			0 9 7½	
	May 2	3 17 6	0 5 1¼	15.18 1	35 2.3	36 7	4.0			0 9 7½	10,246,586*
	Sept. 2	3 17 6	0 5 1	15.24 1	35 3.9	35 0		1 0		0 9 7½	
5	Jan. 2	3 17 6	0 5 2¼	14.94 1	34 7.6	34 6		0.4		0 9 7½	
	May 1	3 17 6	0 5 1	15.24 1	35 3.9	34 4		2.8		0 9 7½	10,139,905
	Sept. 1	§	0 5 5½			32 6					
6	Jan. 1		0 5 5½			32 7					
	May 3		0 5 5			33 10					10,106,165*
	Sept. 2	3 17 6	0 5 3½	14.64 1	33 11.2	33 7		1.		0 9 7½	
7	Jan. 3	3 17 6	0 5 5	14.30 1	33 1.8	35 6	7.				
	May 2	3 17 6	0 5 6	14.09 1	32 7.9	36	10.			0 9 7½	11,019,829 ‡
	Sept. 1	3 17 10½	0 5 1	15.31 1	35 5.9	38	7.				
8	Jan. 2	3 17 10½	0 5 0	15.57 1	36 1.1	38 2	5.7				
	May 1	3 17 10½	0 5 1½	15.19 1	35 2.5	37 8	7.				12,579,616
	Sept. 4	3 17 10½	0 5 1	15.31 1	35 5.9	37 6	5.6				
9	Jan. 1	3 17 9	0 5 2	15.05 1	34 10.5	37 7	7.7			0 3 2½	
	May 3	3 17 9	0 5 2	15.05 1	34 10.5	35 6	1.8			0 3 2½	13,450,294
	Sept. 3	3 17 9				33 4				0 3 2½	
										Per centage of Discount on Bank Notes.	
1800	Jan.† 3		0 5 7			32					
	May 2	4 5 0	0 5 9½	14.68 1	34 0.4	32 5		5.3	9 2 11¾	8 7 7¾	15,160,635
	Sept. 2	4 5 0	0 5 9½	14.68 1	34 0.4	32 2		5.5	9 2 11¾	8 7 7¾	
1	Jan. 2	4 6 0	0 5 10½	14.64 1	33 11.2	29 8		12.6	10 8 8	9 8 11¼	
	May 1	4 3 0	0 6 1½	13.74 1	31 10.	31 6		1.	6 11 7¾	6 3 7¼	15,810,902
	Sept. 1		0 6 0½			31 7					
2	Jan. 1	4 3 6				32 2			7 4 5½	6 14 8¾	
	May 4		0 5 9½			32 8					16,427,889
	Sept. 3		0 5 6			33 3					
3	Jan 4		0 5 7			34					
	May 3		0 5 8			34 4					16,505,272
	Sept. 2		0 5 6			32 10					
4	Jan. 3		0 5 8½			34 10					
	May 1					35 9					17,408,060
	Sept. 4	4 0 0	0 5 4	15. 1	34 9.3	35 10	3.		2 14 6¾	2 13 1½	
5	Jan. 1	4 0 0	0 5 6½	14.44 1	33 5.7	35 6	6.0		2 14 6¾	2 13 1½	
	May 3	4 0 0	0 5 4½	14.88 1	34 5.9	35 5	2.6		2 14 6¾	2 13 1½	16,826,071
	Sept. 3	4 0 0				35 5			2 14 6¾	2 13 1½	
6	Jan. 3					33 3					
	May 2		0 5 9			33 8					16,791,824
	Sept. 2		0 5 7½			34 4					
7	Jan. 2		0 5 8			34 8					
	May 1		0 5 7½			34 10					16,705,903
	Sept. 4		0 5 7½			34 3					
8	Jan. 1					34 4					
	May 3					34 9					17,128,649
	Sept. 2					34 8					

* Average of January and July.

§ Wherever a blank space is left, it shows that no prices of bullion are quoted of that date, either at Lloyd's, or at the *Bullion Office* in the Bank of England.

‡ From 1797, the account of Bank of England notes in circulation is taken from the Table, in page 323 of the Appendix to the Lords' *Report on the Expediency of the Bank's resuming Cash payments*. On the 25th February 1797, the epoch of the *restriction* on cash payments, there were only L. 8,640,250 notes in circulation.

† From 1800 to 1810, standard gold and silver in bars are not regularly quoted. Portugal gold in coin, being nearly of the same standard, has in several instances been quoted as standard gold. In those instances where standard silver is not quoted, the deficiency has been supplied by adding 2½d. to the ounce of new dollars, the computed difference in the value of the two standards.

Tables.

		Price of Standard Gold *per* oz. L. s. d.	Price of Standard Silver *per* oz. L. s. d.	Their relative proportions to each other.	Par of Exchange with Hambro. Sch. gr.	Course of exchange with Hambro.	*Per cent.* in favour of London.	*Per cent* against London.	*Per centage* above the Mint price of Gold. L. s. d.	*Per centage* of Discount on Bank Notes. L. s. d.	Bank of England Notes in Circulation.
1809	Jan. 3		0 5 7½			31 3					
	May 2	4 11 0	0 5 6½	16.42 to 1	38 0.8	30 6		19.9	16 17 1¼	14 8 5½	18,927,833
	Sept. 5	4 9 10½	0 5 8½	15.74 1	36 10.9	29 0		21.4	15 8 2¼	13 7 0¼	
10	Jan. 2	4 9 10½	0 5 7½	15.97 1		29 3			15 8 2¼	13 7 0¼	
	May 1					31 3					22,541,523
	Oct. 9	4 5 0				31 0			9 2 11¾	8 7 7¾	
11	Jan. 22	4 7 6	0 5 11½	14.68 1	34 9.9	26 0		25.3	12 7 2¼	11 0 0	
	May 14		0 6 1			24 0					23,282,671
	Aug. 30		0 6 2			25 6					
12	Jan. 31	4 18 6				27 6			26 9 8¼	20 18 9½	
	May 22	4 17 0	0 6 4	15.32 1	35 6.2	29 0		18.4	24 11 2½	19 14 5	23,237,318
	Oct. 2	5 7 0				28 0			37 8 0¼	27 4 7¼	
13	Jan. 22	5 4 0				29 0			30 10 11¾	25 2 7	
	May 21	5 3 0	0 6 10	15.07 1	34 11.2	28 0		24.6	32 5 3½	24 8 0	24,023,569
	Oct. 1	5 8 0	0 6 11	15.61 1	36 2.3	26 6		29.1	38 13 8½	27 18 0	
14	Feb. 8	5 8 0	0 6 11½	15.52 1	35 6.8	29 0		14.5	38 13 8½	27 18 0	
	May 24	5 3 0				28 0			32 5 3½	24 8 0	26,901,922
	Oct. 4	4 5 0	0 5 8	15 1	34 9.3	32 10		5.6	9 2 11¾	8 7 7¾	
15	Jan. 3	4 6 6	0 5 9	15.04 1	34 10.4	32 4		7.3	11 2 8¼	9 19 5¼	
	May 2	5 6 0	0 6 9½	15.61 1	36 2.3	28 2		22 2	36 2 4¼	25 16 9¾	26,887,017
	Sept. 15	4 9 0	0 5 9	15.48 1	35 10.6	32 9		8.7	14 5 9	12 10 0	
16	Jan. 16	4 2 0	0 5 4½	15.63 1	36 2.8	34 4		5.2	5 5 11¾	5 0 7¼	
	May 28	4 0 0	0 5 1½	15.51 1	36 2.3	35 10		1.0	2 14 6¾	2 13 1½	26,574,840
	Oct. 1	3 19 0	0 5 0	15.80 1	36 7.5	36 11	0.8		1 9 9	1 8 7	
17	Jan. 17	3 19 6	0 5 0½	15.77 1	36 6.7	36 1		1.3	2 11 1¼	2 0 10¾	
	June 6	3 19 0	0 5 3	15.05 1	34 10.7	35 0	0.3		1 9 9	1 8 7	28,274,901
	Sept. 5	4 0 0	0 5 3	15.24 1	35 3.9	35 2		0.5	2 14 6¾	2 13 1½	
18	Jan. 9	4 0 6	0 5 3½	15.21 1	35 3.1	34 6		2.2	3 8 5¾	3 5 2¾	
	May 26	4 1 6	0 5 5½	14.93 1	34 7.3	33 11		2.0	4 13 1	4 8 11½	27,221,208
	Sept. 15	4 0 0	0 5 4	15.00 1	34 9.3	35 2	1.1		2 14 6¾	2 13 1½	
19	Jan. 8	4 3 0	0 5 5½	15.20 1	35 2.9	33 9		1.9	6 11 7¾	6 3 7	
	Mar. 23	4 1 0	0 5 6	14.72 1	34 1.5	34 4	0.6		4 0 3½	3 17 2½	

I.—ACCOUNT of the COURSE OF EXCHANGE of Dublin on London, from 1790 to 1810, inclusive. (The first *fourteen* years are taken from the Table in page 149 of Mr Parnell's pamphlet; and the remaining *seven* years from the Tables in the Appendix to the *Bullion Report*.)

	1790.	1791.	1792.	1793.	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.	1806.	1807.	1808.	1809.	1810.
Jan. 1	8¼	8¼	8¾	8½	8½	8⅝	8⅓	10¼	8⅝	10	13½	11	11½	12	15½	8½	11½	11	9⅜	8¾	8
Feb. 1	8⅜	8¾	8¾	8¾	9	8¼	9¼	8¾	9	9¼	12¼	12¼	12	12⅞	16½	10½	11½	10¾	9½	7¾	8¼
Mar. 1	8½	8⅝	8½	9½	8½	8½	9	9¼	9¼	9⅞	12	12½	12½	13⅜	17	9½	11¼	10	9¼	7¼	8¼*
April 1	8¾	8¼	8¼	9½	8	8¼	9½	6½	9	11	11¼	14	13	14¼	16¼	11	11¼	9¾	9¼	7¼	
May 1	8¼	8⅜	8⅛	10½	8⅜	8½	9	8½	9¼	10	11¾	14	11¼	14¼	15	11	10½	9¾	9¾	8	
June 1	8½	8¼	8⅝	10½	8⅝	8¼	10	8¼	9½	11¼	10¼	13½	12½	13½	11	11	11	9¾	10	9½	
July 1	8½	8½	9	10½	8⅝	8¾	9⅞	7¾	9¾	11¾	10¼	16	12¾	14½	12	11⅛	10¾	9½	9¾	9¼	
Aug. 1	8⅞	9	8⅞	10	8⅝	8½	10¼	7¾	8	11⅝	11¼	14	11½	17	11½	12½	10¾	9¾	9¾	9½	
Sept. 1	8⅝	8½	8⅝	9¼	8⅝	8⅝	10¼	7	8	11⅝	12¼	16	12¼	15½	11¾	12	11	9⅝	9½	9½	
Oct. 1	8	9	8¼	9	8¼	8	10¼	7¼	9	12	10⅛	13½	12	17	12½	11½	10¾	9½	9	8¾	
Nov. 1	8	8½	8¼	8½	8¼	8¼	10¼	7¼	9¼	12½	10⅝	11	12	15½	12¼	11¼	11½	9½	8¾	8½	
Dec. 1	8½	8⅛	8¼	8⅝	8¼	8¼	10⅜	7	9¼	14½	10½	11	12	16¼	11½	11⅜	10¾	9⅝	7½	8¼	

* It appeared from the evidence taken before the Committee on Irish Exchange in 1804, that the expence of transmitting L. 100 in cash from London to Dublin, and *vice versa*, varied from 1 to 1½ *per cent.*; and it is stated by Mr Foster (*Essays on Commercial Exchange*, p. 175), that in the long interval from 1728 to 1797, the exchange never varied beyond the expence of sending gold from the one country to the other except in 1753, when the paper currency of Dublin had been very much depreciated. (See Mr Parnell's pamphlet *On the Principles of Currency and Exchange*, 4th edit. p. 168.)

Tables.

III.—ACCOUNT of the Number of BANK OF IRELAND Notes in circulation, including Bank Post Bills, in each half year, commencing with the half year ending 1st January 1797 to 1st January 1819, inclusive. (From an Account printed by order of the House of Commons.)

1797, January 1,	L. 733,763	3	1	1809, January 1,	L. 3,002,699	1	8
July 1,	785,101	9	1	July 1,	3,144,677	4	3
1798, January 1,	1,081,512	18	1	1810, January 1,	3,170,064	17	1
July 1,	1,245,214	17	11	July 1,	3,171,607	13	3
1799, January 1,	1,363,710	17	9	1811, January 1,	3,331,892	16	0
July 1,	1,557,737	12	4½	July 1,	3,472,781	11	9½
1800, January 1,	1,928,381	4	1½	1812, January 1,	3,616,476	13	10
July 1,	2,317,235	6	9	July 1,	3,763,229	11	7½
1801, January 1,	2,350,133	8	7½	1813, January 1,	3,957,920	3	10½
July 1,	2,323,901	19	11	July 1,	4,199,474	16	4½
1802, January 1,	2,431,152	16	1	1814, January 1,	4,165,906	12	7½
July 1,	2,587,187	9	2½	July 1,	4,281,449	17	11
1803, January 1,	2,662,405	5	6	1815, January 1,	4,528,041	7	1
July 1,	2,617,144	10	4½	July 1,	4,434,455	0	4
1804, January 1,	2,798,767	15	7	1816, January 1,	4,179,549	4	6½
July 1,	2,859,977	13	7½	July 1,	4,193,853	11	4½
1805, January 1,	2,817,697	7	3	1817, January 1,	4,277,018	15	2½
July 1,	2,778,635	12	4	July 1,	4,304,040	11	7½
1806, January 1,	2,560,271	12	3	1818, January 1,	4,387,155	5	4½
July 1,	2,517,581	8	11	July 1,	4,413,463	8	0
1807, January 1,	2,693,796	7	1½	1819, January 1,	4,477,019	2	5
July 1,	2,789,544	16	6				
1808, January 1,	2,746,717	5	2				
July 1,	2,798,835	10	9½				

IV.—PAR of EXCHANGE between England and the following places, viz. Amsterdam, Hamburgh, Paris, Madrid, Lisbon, Leghorn, Genoa, Naples, and Venice, the same being computed from the intrinsic Value of their principal Coins, by comparing Gold with Gold, and Silver with Silver, according to their Mint Regulations, and to Assays made at the London and Paris Mints. (Given in by Dr Kelly to the Committee of the House of Lords, appointed to inquire into the expediency of the Bank's resuming Cash Payments.)

	GOLD.		SILVER.				EXPLANATIONS.
			Old Coinage.		New Coinage.		
	Mint Regulations.	Assays.	Mint Regulations.	Assays.	Mint Regulations.	Assays.	Monies of Exchange.
Amsterdam, Banco	36 8	36 6,8	37 3	37 10,5	35 0	35 6,5	Schillings and Pence Flemish *per* Pound Sterling. Agio 2 *per cent.*
- do. Current	11 4,5	11 3,8	11 8,5	11 11,8	10 14,6	10 17,6	Florins and Stivers *per* Pound Sterling.
Hamburgh -	34 3,5	34 1,5	35 1	35 1,3	32 11	32 11,5	Schillings and Pence Flemish Banco *per* Pound Sterling.
Paris -	25 20	25 26	24 73	24 91	23 23	23 40	Francs and Cents *per* Pound Sterling.
Madrid -	37.3	37.2	39.2	39.0	41.7	41.5	Pence Sterling for the Piastre or Dollar of Exchange.
Lisbon -	67.4	67.5	60.41	58.33	64.30	62.09	Pence Sterling *per* Milree.
Leghorn -	49.1	49.0	46.46	46.5	49.60	49.5	Pence Sterling *per* Pezza of Exchange.
Genoa -	45.5	45.5	46.46	48.9	49.4	52.0	Pence Sterling *per* Pezza Fuori Banco.
Naples -	41.22	- -	41.22	- -	43.9	- -	Pence Sterling *per* Ducat (New Coinage of 1818).
Venice -	46.3	46.0	47.5	49.0	44.6	46.1	Lire Piccole *per* Pound Sterling.

V.—TABLE containing the Value of the MONIES OF ACCOUNT of different Places (expressed in Pence and Decimals of Pence), according to the Mint Price both of Gold and Silver in England; that is, L.3, 17s. $10\frac{1}{2}$d. *per* oz. for Gold, and 5s. 6d. (as fixed in the New Coinage) *per* oz. for Silver.

Place	Money	Value in Silver.	Value in Gold.
		d.	*d.*
Aix la Chapelle,	Rixdollar current,	33, 43	31, 43
Amsterdam,	Rixdollar banco (agio at 4 *per cent.*),	58, 16	variable
	Florin banco,	23, 26	ditto
	Pound Flemish banco,	139, 56	ditto
	Rixdollar current,	55, 93	ditto
	Florin current,	22, 35	ditto
	Pound Flemish current,	134, 13	ditto
Antwerp,	Pound Flemish (money of exchange),	131, 20	123, 87
	Florin (money of exchange),	21, 87	20, 64
	Pound Flemish current,	112, 47	106, 18
	Florin current,	18, 73	17, 70
Barcelona,	Libra Catalan,	30, 28	26, 70
Basil,	Rixdollar, or ecu of exchange,	50, 32	47,
	Rixdollar current,	45, 19	42, 20
Berlin,	Pound banco,	50, 29	variable
	Rixdollar current,	38, 32	ditto
Bern,	Ecu of 3 livres,	45, 39	42, 90
	Crown of 25 batzen,	37, 82	35, 75
Bremen,	Rixdollar current,	40, 24	variable
	Rixdollar in Carls d'or,	——	39, 68
Cassel,	Rixdollar current,	40, 24	variable
Cologne,	Rixdollar specie of 80 albuses,	33, 40	ditto
	Rixdollar current of 78 albuses,	32, 25	ditto
Constantinople,	Piastre, or dollar,	13, 96	uncer.
Dantzic,	Gulden or Florin,	9, 58	9,
Denmark,	Rixdollar specie,	58, 25	——
	Rixdollar crown money,	51, 49	——
	Rixdollar Danish currency,	47, 13	44, 88
England,	Pound Sterling,	240,	240,
Florence,	Lira,	8, 62	8, 53
	Ducat, or crown current,	60, 36	59, 71
	Scudo d'oro, or gold crown,	——	63, 97
France,	Livre Tournois,	10, 16	9, 38
	Franc (new system),	10, 33	9, 52
Francfort,	Rixdollar convention money,	40, 24	37, 65
	Rixdollar Muntze, or in small coins,	33, 53	——
Germany,	Rixdollar current,	40, 24	variable
	Rixdollar specie,	53, 65	ditto
	Florin of the Empire,	26, 83	ditto
	Rixdollar Muntze,	33, 53	ditto
	Florin Muntze,	22, 36	ditto
Geneva,	Livre current,	17, 17	16, 93
	Florin,	4, 89	4, 84
Genoa,	Lira fuori Banco,	8, 50	7, 83
	Pezza, or dollar of exchange,	48, 90	45, 02
	Scudo di cambio, or crown of exchange,	39, 12	36, 02
Hamburgh,	Mark Banco (at a medium),	19, 39	variable
	Pound Flemish Banco,	145, 46	ditto
	Mark current,	15, 78	variable
	Pound Flemish current,	118, 32	ditto
Hanover,	Rixdollar, *in cash*,	44, 71	42, 26
	Rixdollar, *gold value*,	41, 51	39, 24
Ireland,	Pound Irish,	221, 56	221, 56
Konigsberg,	Gulden or florin,	12, 77	variable
Leghorn,	Pezza of 8 reals,	49, 76	49, 16
	Lira moneta buona,	8, 65	8, 55
	Lira moneta lunga,	8, 29	8, 19
Leipsic,	Rixdollar convention money,	40, 24	variable
	Rixdollar in Louis d'ors or Fredericks,	——	39, 68
Malta,	Scudo or crown,	22, 69	23, 34
Milan,	Lira Imperiale,	11, 08	10, 53
	Lira corrente,	7, 83	7, 44
	Scudo Imperiale,	64, 83	61, 60
	Scudo corrente,	45, 05	42, 78
Modena,	Lira,	3, 53	——
Munich,	Gulden or florin,	22, 36	21, 28
Naples,	Ducat of 1818,	43, 90	41, 22
Parma,	Lira,	2, 60	2, 40
Persia,	Toman of 100 mamoodis,	306, 15	——
Poland,	Gulden or florin,	6, 42	6, 27
Portugal,	Milree,	73, 18	67, 34
	Old Crusade,	29, 27	26, 94
Riga,	Rixdollar Alberts,	55, 93	variable
	Rixdollar currency (agio at 40 *per cent.*),	39, 95	ditto
Rome,	Scudo or crown,	55, 40	51, 63
	Scudo di Stampa d'oro,	84, 49	78, 73
Russia,	Ruble,	40, 98	39, 35
Sardinia,	Lira,	19, 38	18, 82
Sicily,	Ounce,	130, 44	124, 80
	Scudo or crown,	52, 18	49, 92
Spain,	Real of old plate,	5, 25	4, 57
	Real of new plate,	5, 58	4, 86
	Real of Mexican plate,	6, 97	6, 07
	Real Vellon,	2, 79	2, 43
	Dollar of old plate or of exchange,	41, 99	36, 59
Sweden,	Rixdollar,	58, 98	56, 43
Switzerland,	Franc (new system),	23, 57	——
Trieste,	Florin, Austrian currency,	26, 83	25, 05
	Lira, Trieste currency,	5, 07	4, 73
	Lira di piazza,	4, 95	4, 63
Turin,	Lira,	12, 01	11, 23
Valencia,	Libra,	41, 99	36, 59
Venice,	Lira piccola (in the old coins),	5, 39	variable
	Lira piccola (in the coins introduced by the Austrians),	4, 52	ditto
Vienna,	Florin,	26, 83	25, 05
Zant,	Real,	4, 32	variable
Zurich,	Florin, money of exchange,	27, 52	ditto
	Florin current,	25, 02	ditto

(S.S.)

Faroe.

FAROE, Faroer, or Feroe, a groupe of European islands, situated in the Northern Ocean, between Shetland and Iceland, about 200 miles northwest of the former. They appear to form the country described by the early Venetian navigators under the name of Friesland, though that term was afterwards applied by the English to the northern extremity of Greenland. These islands are twenty-two in number, of which the principal are Stromoe, Osteroe, Suderoe, Wangoe, and Sandoe. They are described at some length in the body of the work, under the head of Feroe; but since that time, a considerable mass of new information has been communicated by the work of the Rev. G. Landt, who resided there, as a clergyman, for upwards of twenty-five years; as well as by the voyage undertaken, in 1812, with a laudable view to the promotion of mineralogical science, by Sir George Mackenzie and Mr Thomas Allan. We shall thus be enabled to introduce some additional particulars.

These islands consist throughout of rocks and hills, rising to a considerable height, and separated from each other by narrow vallies, or rather ravines. Although, however, these hills rise abruptly, there are often on their summits, or at different stages of their ascent, plains of considerable magnitude. They everywhere present to the sea perpendicular cliffs, broken into a thousand fantastic forms, and which, to those who sail along the coast, present at every turn the most picturesque and varied scenery. The highest peak is that of Skellingfell, in the island of Stromoe, which is supposed to rise about 3000 feet above the sea. The rocks consist generally of trap, and exhibit little variety of composition, though they present some striking geological phenomena. The zeolites and chalcedonies here collected have long supplied the best specimens of these minerals to the cabinets of Europe. Mr Allan was surprised to find these beautiful minerals so little prized in their native region, that no one in the capital could give him any idea where they were to be found. By his own search, however, he obtained some very splendid specimens, particularly of several rare species of zeolite.

The population of the Faroe Islands, according to a statistical table drawn up in 1812, amounted to 5209. Agriculture is in a very imperfect state, the infield, or cultivated land, being supposed to bear to the outfield, or uncultivated, the proportion of 1 to 60. The plough is scarcely ever used, being in fact ill suited to the rugged and uneven surface of which all the islands consist. The ground is therefore turned up with the spade, care being taken not to destroy the roots of the grass. Horses and cows are few in number, and the latter give very little milk, in consequence, probably, of the coarse hay upon which they are fed. Sheep form the chief riches of the islanders, and the number possessed by them was calculated, in 1812, at 35,307. Some individuals have flocks of two or three hundred. These sheep are allowed to run about, both in summer and winter, without ever being housed, and in severe seasons suffer considerably. The wool is generally coarse, and is torn off the animals in so rough a manner, as often to lacerate the skin. The fishery, which was once considerable, has been neglected, and is now of little consequence. The catching of the numerous birds which build their nests upon the face of the cliffs, forms a great source of subsistence to the inhabitants. Those employed in this hazardous trade display great ingenuity, and the most adventurous spirit. Sometimes the fowler is let down from the top of the cliff by a rope fastened to his waist. At other times, where there is any footing at all, he climbs the steepest rocks, or, where that is impossible, has himself thrust up by poles made for the purpose. The puffin (Alca Arctica) is the most common of these birds, and the eider duck is here often shot for food.

Faroe.

The Danish government has given the monopoly of the trade of the Faroe Islands to a mercantile house at Copenhagen (Frische and Company), under the condition of supplying the inhabitants with a sufficient quantity of grain, at a constant fixed price. Should the market price be such as to render this a losing transaction, the merchant is indemnified by government. This care of provisioning the islands is probably superfluous; and the natural bad effects of a monopoly are felt in the high price of other imported articles,—a good jacket being often given for a few leaves of tobacco. The exports consist of hose knit on the islands, to the annual amount of 100,000 pairs, tallow, fish, train-oil, feathers, skins, and butter. During the late war between Britain and Denmark, the fort of Thorshaun was, in 1808, destroyed by Captain Baugh, lest it should afford harbour to privateers. A German adventurer, who assumed the name of Baron Hompesch, afterwards landed and plundered the place; but his conduct was handsomely disavowed by the British government, who even restored the value of the property of which the natives had been robbed. Finding, also, that the people having lost their communication with Denmark, were in danger of suffering from famine, she permitted a limited intercourse to be carried on, under licence, from Leith. The peace has since restored all things to their usual channel.

Thorshaun, the principal place in the country, does not contain above 518 inhabitants. It is situated on the eastern coast of the island of Stromoe, upon a narrow tongue of land, having creeks on each side where ships may be safely moored. The houses are built of wood, and roofed with birch bark covered with turf; the greenness of which makes it impossible, at a very short distance, to distinguish the place from the surrounding fields. The character of the people is generally marked by great simplicity of manners, kindness, and hospitality.—See *A Description of the Faroe Islands*. By the Rev. G. Landt. Translated from the Danish. London, 1810.—*An Account of some Geological Facts observed in the Faroe Islands*. By Sir George Stewart Mackenzie, Bart. (*Transactions of the Royal Society of Edin.* Vol. VII.)—*An Account of the Mineralogy of the Faroe Islands*. By Thomas Allan, Esq. (*Ibid.*) (B.)

Ferguson. FERGUSON (ADAM, LL. D.), a distinguished Philosopher and Historian, was born at Logierait, in the Highlands of Perthshire, on the 20th of June 1723. His father, the Reverend Adam Ferguson, a native of the neighbouring parish of Moulin, had been minister of Crathie and Braemar, in Aberdeenshire, from 1700 to 1714; and, on the eve of the ensuing Rebellion, had been translated to Logierait, where he passed the remainder of his long life, discharging the duties of his laborious charge with such exemplary piety, fidelity, and firmness, that, though, at the period of his induction, the parishioners were almost universally hostile to Presbyterian principles, he speedily secured the respect and admiration of all ranks; and, till the close of his incumbency, in 1754, retained a degree of influence which proved that his knowledge of mankind was not inferior to his zeal for their religious improvement. This excellent man left a numerous family, of whom Adam was his youngest son, by Mary Gordon, daughter of Mr Gordon of Hallhead, in Aberdeenshire.

It is believed that Adam received the first part of his education at the village school of his native parish, under the superintendence of Mr John Connacher, of whose literary attainments little can now be ascertained, though some of his pupils are still alive. Whatever might be the merits of this teacher, they do not seem to have been estimated so highly as those of the schoolmaster of Dunkeld and Perth; to one or other of which places it was at this time customary for the parishioners of Logierait to send such of their sons as they wished to prepare for a course of academical study. Two, at least, of Mr Ferguson's younger sons attended the grammar-school of Perth, between the years 1732 and 1738, while Mr James Martin was Rector, and Mr Andrew Cornfute one of the assistants. Under the tuition of these able and diligent instructors, Adam is said to have made uncommon progress in classical literature; and, in addition to the benefit which he derived from his teachers, he possessed the advantage of living under the protection of a respectable citizen, William Ferguson, his relative, a merchant in the town, and at one time chief-magistrate.

Towards the end of autumn 1738, when he had entered into his sixteenth year, he was removed from school to the University of St Andrews, where his father had commenced his studies fifty years before, under a very meritorious Regent, Mr John Row, son of the minister of Ceres; who, being grandson of the well-known David Ferguson, minister of Dunfermline, was induced, by the claims of kindred, as well as of duty, to pay particular attention to the improvement of a youth whom he soon discovered to be highly deserving of his favour. It so happened, that one of the colleagues of Mr Row was still a master of St Leonard's College, and that all the other masters were of nearly the same standing with the elder Mr Ferguson, who was thus confirmed in his preference of the college in which he had prosecuted his own philosophical studies. At this very juncture, the Principal of St Leonard's College died, and the other Professors, at whose almost unanimous recommendation, Mr Tullideph was appointed to the vacant chair, anticipated the most prosperous results from his efforts to promote the good of an establishment which they considered as having fallen into disrepute, in consequence of the feeble and undignified administration of his predecessors.

Ferguson. The Greek class in St Leonard's College was at this time taught with great reputation, by Mr Francis Pringle, who had obtained his office in 1699; but, though no other teacher of that language in Scotland could pretend to rival him, the average number of students who were received annually under his charge, from 1738 to 1747, was not more than eleven; while the average of entries to the corresponding class in St Salvator's College scarcely amounted to six. Adam Ferguson was enrolled in Mr Pringle's class as a ternar, the same rank of students which, in the days of Buchanan, was characterized by the term *pauper;* that is to say, one who pays the lowest rate of fees. It has been alleged that Ferguson, after a comparative trial, was admitted one of the foundation bursars, having stood first in the list of successful competitors. If it were so, the victory was not very splendid, as, of the twelve who entered the class along with him, not more than eight (being of the denomination of ternars) could have been permitted to take a share of the contest.

Besides Pringle, the other masters in St Leonard's College were, John Craigie, admitted Professor of Philosophy in 1691, Ninian Young, Professor of Humanity, and Henry Rymer, Professor of Philosophy, both admitted in 1709, and David Young, Professor of Philosophy, admitted in 1716. Before the end of the Session 1739, Charles Gregory, Professor of Mathematics, resigned in favour of his son, David, who, though a very ordinary man, was the most popular teacher of geometry ever known in that University, which had many years before numbered among its Professors the inventor of the reflecting telescope.

The method of teaching in St Leonard's College at this period did not materially differ from that which had been pursued in the former century. The Professors, in general, followed the beaten track in which they had been guided by their predecessors; and the tasks which they exacted from the students were little more than exercises of memory. A young man of slender abilities might easily distinguish himself as much as his most ingenious associates, who might be apt to underrate acquirements which were more accessible to plodding industry than to original talents. We have good reason to believe that Ferguson acquired little more at this seminary than a high admiration of the Grecian and Roman literature, to the beauties of which he was more nearly introduced than he had hitherto been; and that his advances in the knowledge of philosophy were all made at a subsequent period. Even under the vigilant and severe inspection of Principal Tullideph, the discipline of the College was by no means good; and, in Mr Pringle's class particularly, some of the young gentlemen conducted themselves so improperly as to have narrowly escaped the disgrace of being refused their degrees, after they had undergone the usual trials. Mr Ferguson obtained the degree of Master of Arts on the 4th of May 1742, when he had nearly completed his nineteenth year. The Regent under whom he finished his course of physical study was Mr David Young, whose text-book was Keill's *Introductio ad veram Physicam.*

The minister of Logierait had attempted to induce some of his other sons to follow his own profession; but, as they had all testified a disinclination to this line of life, he determined to breed his youngest son to the church; and, accordingly, he was sent to the Divinity Hall at St Andrews, in November 1742, when

the theological department of study was superintended by Principal Murison and Professors Shaw and Campbell; the last of whom, a man of talents and learning, was well known by his writings; but, like several of his predecessors in the same chair, he scarcely ever lectured at all. Mr Ferguson studied also a year or two at Edinburgh under Professors Gowdie and Cuming; but his attention appears to have been given chiefly to pursuits not immediately connected with his clerical views.

In the year 1745, when he had attended Divinity only one-half of the usual period, an appointment was offered to him, which he could not hold without ordination. It was represented to the General Assembly, that Lord John Murray, Colonel of the Highland Regiment (the 42d), was desirous of having a chaplain of the communion of the Church of Scotland possessed of the Irish language; and that Mr Adam Ferguson, though he had not studied divinity the full period of six years, was pitched upon for that office, provided the Assembly would allow the Presbytery of Dunkeld to take him on trials. The Assembly, in respect of the young man's capacity and good character, authorized the Presbytery to ordain him on passing his first trials; and, accordingly, he was ordained at Dunkeld, on the 2d of July 1745. A few days afterwards he joined the regiment, in which he continued to serve till 1757; about the beginning of which year he was elected keeper of the Advocates' Library, on the resignation of the celebrated David Hume. About a year after, Mr Ferguson was succeeded in this office by Mr William Wallace *junior*, advocate.

In the course of the year 1767, Mr Ferguson rendered himself conspicuous by the interest which he took in the success of the Tragedy of *Douglas*, written by his friend Mr Home. He published a defence of the *morality of stage plays*, which, though its merit is not of the highest order, was admitted by the opposite party to be "the only piece on that side that was written with any tolerable degree of discretion." After Mr Home resigned his living in June 1757, Mr Ferguson and he retired to country lodgings at Braid, in the neighbourhood of Edinburgh, where they spent a few months in a course of laborious study, enlivened by the intercourse of friendship. As Mr Ferguson's campaigning habits had reconciled him to a migratory life, it is not easy to trace him through all his changes of residence. During his father's lifetime he had great satisfaction in making occasional excursions to the Highlands, and thinking aloud in his solitary walks, amidst the lakes and forests of Rannoch, or on the summit of his native mountains, where one of the most magnificent prospects in nature was displayed before his eyes. It was here that the lofty enthusiasm of his spirit was nursed and matured; and it was not so much in the intercourse with polished society as in the wilds of Athol that he acquired that dignity and ease of manner for which he was distinguished above most of the literary men of his country. To use his own expressive words: "If I had not been in the Highlands of Scotland, I might be of their mind who think the inhabitants of Paris and Versailles the only polite people in the world. It is truly wonderful to see persons of every sex and age, who never travelled beyond the nearest mountain, possess themselves perfectly, perform acts of kindness with an aspect of dignity, and a perfect discernment of what is proper to oblige. This is seldom to be seen in our cities or in our capital; but a person among the mountains, who thinks himself nobly born, considers courtesy as the test of his rank. He never saw a superior, and does not know what it is to be embarrassed. He has an ingenuous deference for those who have seen more of the world than himself; but never saw the neglect of others assumed as a mark of superiority."

In the year 1759, he was elected Professor of Natural Philosophy in the University of Edinburgh, in the room of Dr John Stewart. He had not made physical science the principal object of his inquiries; and, indeed, he had not studied it much more attentively than most young men do in the common routine of academical instruction. But with only four months to prepare for the labours of the winter, he qualified himself so well as to give universal satisfaction. He conducted this branch of education five years, and by adapting his lectures to the capacities of the young, contrived to render the study more interesting than it had been commonly considered. At this time he was a member of the well-known *Select Society* of Edinburgh, instituted in 1754, for the purpose of promoting philosophical discussion, and training the members to the practice of public speaking. The ardour of this society did not begin to languish till the year 1762, when another association, equally celebrated, was formed by the literary circle of Edinburgh; the design of which was to rouse the country to demand from the Legislature the establishment of a militia in Scotland. Mr Ferguson may almost be considered as the founder of this society; and it was at his suggestion that it received a name (The *Poker*) which was sufficiently significant in the ears of the initiated, but utterly unintelligible by strangers. His satirical pamphlet, entitled, *The History of Sister Peg*, was intended to forward the object of this patriotic society; and it is perhaps the only production connected with that cause, which, at this distance of time, is capable of exciting any interest.

In 1763, Mr Ferguson was applied to by the Earl of Warwick to take charge of his two younger sons, the Honourable Charles and Robert Greville, whose eldest brother Lord Greville had received part of his education under the eye of Principal Robertson. These young gentlemen resided some years in his house, and both they and their tutor Mr Macpherson repaid his attention to their improvement by the warmest affection and gratitude. Lord Warwick, who had been advised by General Clerk to place his sons under Mr Ferguson's care, was not insensible of the "great benefit they had reaped from his tuition, and advantageous as well as manly and friendly conversation." Mr, afterwards Sir John, Macpherson, at the same time acknowledged, that "to him he owed all his knowledge, as well as all his success in life."

On the appointment of Mr Balfour to the Professorship of the Law of Nature and Nations, in 1764, Mr Ferguson was elected by the Magistrates of Edinburgh to succeed him in the chair of Moral Philosophy. This had long been a favourite object of his ambition, and about ten years before, when the able and accomplished Mr Cleghorn was on his death-bed, he urged his young friend to apply for the office,

which, in his apprehension, no man was more capable of adorning. Mr Cleghorn, after expressing his regret at having no such influence with the patrons as to secure such an arrangement, added, as Mr Ferguson sometimes related with much emotion, "I can only say of you, as Hamlet did of Fontinbras, *He has my dying voice.*"

Mr Ferguson entered on his new duties with a degree of spirit and activity, from which the most splendid results were to be anticipated. In one particular, his mode of lecturing was singular, and not easily imitated. After having delineated the general plan of his course, and committed it to writing, he resolved not to write a system of lectures, but to endeavour to make himself master of every part of his subject, and to trust to the moment of delivery for the expression of his sentiments. This method of discoursing was in his hands very happily executed; but its success depended, in a great measure, on the state of his health and spirits, as well as upon the interest excited by the different subjects of discussion. Perhaps no lecturer, with the exception of his immediate successor, was ever more admired. His class was crowded by great numbers of gentlemen of high rank and official station, as well as by younger students. In the mean time, eagerly as he applied to the discharge of his professional duties, his attention was extended to other branches of inquiry; and within little more than a year after he commenced his labours as a lecturer on morals, he sent to the press, his *Essay on the History of Civil Society;* a work which was received with an expression of public applause, which even exceeded the high expectations of his friends. "Ferguson's book (says Mr Hume, writing to Dr Robertson from London) goes on here with great success." Gray, the poet, says, "There are uncommon strains of eloquence in it; and I was surprised to find not one single idiom of his country (I think) in the whole work." Mr Hume, in a letter to the author (dated 10th March 1767), congratulates him on the success of the book, adding that he had "met with nobody that had read it who did not praise it. Lord Mansfield is very loud to that purpose in his Sunday Societies. I heard Lord Chesterfield and Lord Lyttleton express the same sentiment; and what is above all, Caddel, I am told, is already projecting a second edition of the same quarto size." Mr Hume then informs him, that Lord Shelburne and Lord Bute were among his most zealous partizans; the last declaring the book one of the best he ever read. Charles Townshend appears to have been of the same opinion, as he read it five times over.

General Clerk had pressed the author to dedicate his work to Lord Shelburne, who had signified his intention of offering Mr Ferguson the government of West Florida; upon which occasion his Lordship laughed very heartily, when the General expressed his conviction, that Mr Ferguson was more usefully employed as a teacher of science. The book, however, appeared without any dedication. In the course of the following year, Lord Shelburne intimated a hope of getting Mr Ferguson established with a proper appointment at Oxford; and some other persons of influence meditated a design of employing him in one of the departments of state. This purpose was frustrated in all probability by a temper, which did not permit him to accommodate himself to the views of those whose maxims of conduct he did not entirely approve. Another circumstance may be considered as having also operated to obstruct the fulfilment of the schemes which were devised for his advancement. At this time he married Miss Burnet, a young lady nearly connected with his mother's family, and still more nearly related to his intimate friend Dr Black. Soon afterwards he began to cultivate a farm in the parish of Currie, and, at a considerable sacrifice of private interest, gratified his taste for improvement by transforming a barren heath into a scene which became distinguished for beauty and fertility.

It was impossible, however, for any combination of circumstances to abate his literary activity; and he not only continued to conduct the business of his class with unremitted diligence, but seized every interval of leisure which he could command, to collect materials for a history of the Roman Commonwealth. While he was proceeding in his researches, he was solicited by Philip, Earl of Stanhope (the editor of Dr Robert Simson's posthumous works), and the other guardians of Charles, Earl of Chesterfield, to superintend the education of that young nobleman, then in his nineteenth year. The negociation was conducted through the mediation of Dr Adam Smith, who, judging the offer to be advantageous to his friend, exerted himself with great earnestness to induce him to accept it. Lord Stanhope was extremely anxious to obtain the able services of Dr Ferguson without delay, as he conceived it to be of the utmost consequence to his young kinsman to be placed under the care of "a person so well qualified to complete the remaining part of his education, and to repair the neglects, omissions, and errors, which had unfortunately been committed in the former part of it." The proposal had originally been made early in the year 1773, and was renewed in December, soon after the commencement of the session of the college, when Dr Ferguson was engaged not only in teaching his own class, but also in lecturing on natural philosophy, the professorship of which had recently become vacant by the death of his relation Mr Russell. He was not able to prevail on the patrons to accept of a substitute to complete the labours of that session; but after obtaining leave of absence for the next session, he joined his young charge at Geneva, in May 1774, and at first entertained hopes that his labours might prove beneficial. The connection, however, was not so agreeable as he expected, and it terminated about twelve months afterwards. In the mean time, he had very nearly been deprived of his office in the University. The town-council had, at his desire, appointed Mr John Bruce (then assistant, and afterwards successor to Mr Stevenson) to teach the Moral Philosophy during the session 1774 and 1775; but before the conclusion of the session, they thought fit to rescind this act, and to declare the office vacant. His friends in the University, particularly Drs Robertson, Blair, and Black, were exceedingly indignant at this proceeding; more especially as Sir John Pringle had been permitted to be several years absent; and at that very time the Professors of Mathematics, and of the Theory of Medicine, had

both been allowed to discharge their duty by substitutes for two years without quarrel. As the council, however, seemed to have determined to fill up the place by a new election, it became necessary for his friends to apply to the Court of Session to put a stop to their proceedings. "I have been much obliged (says he, in a letter to a friend) to the general voice that was raised in my favour, as well as to the ardent zeal of particular friends. Ilay Campbell (afterwards Lord President) has given me proofs of friendship which I can never forget. Pulteney has behaved to me in every thing as he would have done at the beginning of the *Poker Club.* I have always been an advocate for mankind, and am a more determined one than ever; the fools and knaves are no more than necessary to give others something to do."

After his return, he continued, as formerly, to divide his time between his literary and agricultural pursuits, and engaged occasionally in the political controversies which agitated the country during the progress of the American war. Besides his pamphlet, in answer to Dr Price's observations on liberty, he communicated his views from time to time to Sir William Pulteney, and other members of Parliament; and when it was resolved by government to send out Commissioners to quiet the disorders in the colonies, he was appointed secretary to the Commission. It appears from a letter of General Putnam, dated July 1778, that the nomination of Dr Ferguson was very agreeable to the more intelligent part of the Americans, who, not without reason, were dissatisfied to find that the commissioners were fettered by restrictions, which rendered their appointment nugatory. "I am very sorry (he writes) that the Parliament of Great Britain is still so blind to their own and our interest, as to send Dr Ferguson and the rest of the worthy gentlemen over to America with limited power, and that to last only till July 1779, and then to be revoked by them if they think fit, by which means I am deprived of seeing your friend Dr Ferguson, which gives me great pain, as I always have heard of his being a gentleman of the first character for learning, good sense, and humanity." It is well known, that the Commissioners returned without accomplishing the object of their mission; but they had an opportunity of acquiring more useful information of the state and temper of the country than government had received in all the previous course of the contest. While Dr Ferguson was absent during the session 1778, 1779, his place was supplied by Mr Dugald Stewart, who, about five years afterwards, was destined to succeed him in the Chair of Moral Philosophy.

In the year 1780 he was seized with an attack of apoplexy, which, though not violent, was sufficient to alarm his friends for his safety. This formidable affection did not, in the slightest degree, impair the force of his understanding; and so abstemious did he afterwards become, as not only to secure himself against the recurrence of the disease, but to enjoy almost uninterrupted health for more than thirty years. As he could not now venture to lecture as formerly without the use of written notes, he therefore found it necessary to write out a course of instruction to be read during the remainder of his incumbency. In his endeavours to recover the substance of his lectures, he availed himself of the notes taken by intelligent young men, who had studied under him different sessions, and who thus might be expected to have preserved the various modes in which he had stated his doctrines, and the different arguments and illustrations by which he had happened to supply in one session what might have been omitted in another. But in the prospect of soon relinquishing his office, it was scarcely conceivable, that the compilation which he thus executed could possess all the excellencies which he was capable of imparting to it; more especially as he was now busy in carrying his great historical work through the press. This was the *History of the Progress and Termination of the Roman Republic,* in three volumes quarto, published in 1783; a book which not only delights by the clearness of its narrative, and the boldness of its descriptions, but instructs and animates by profound and masterly delineations of character, as well as by the philosophical precision with which it traces the connection of events. It is written in that tone of high-minded enthusiasm, which, if it can only snatch from oblivion whatever is noble and generous in the record of human actions, regards the graces of style as objects merely of secondary account, and is chiefly studious of impressing the lessons of wisdom, which may be gathered from the survey of distant ages.

The fatigues and anxieties of public teaching now became oppressive to his spirits, and not altogether favourable to his health; and he therefore deemed it expedient to resign his office in 1784, when he had completed his sixty-first year. Mr Dugald Stewart, then Professor of Mathematics, succeeded to his office; and in order to entitle Dr Ferguson to retain his salary, he was conjoined in the Professorship of Mathematics with the late lamented Mr Playfair. He now proceeded to revise the notes of his lectures on ethics and politics, with a view to publication; and, in 1792, the work appeared under the title of *Principles of Moral and Political Science.* Though composed under disadvantageous circumstances, and though it has omitted many of the questions which were treated in his elementary course, it contains an admirable view of the systems both of ancient and modern philosophers, particularly on the foundations of moral approbation, and the sources of private happiness and public security. The authors to whose suggestions he was most indebted were Xenophon, Plato, and Aristotle among the Greeks, Cicero and Seneca among the Latins, Epictetus and Antoninus among the later scholars of the Grecian school; and, among the moderns, Shaftesbury, Hutcheson, Montesquieu, and Adam Smith. It has been considered as a blameable omission in this work, that too slight notice is taken of the importance of religious principle; and the author seems to have been aware that he had exposed himself to this objection. No man, however, was ever more anxious to establish the foundations of natural theology, and to strengthen the arguments for a future state; on which subjects the work abounds in passages of uncommon beauty.

After the publication of this work, Dr Ferguson, now in his 70th year, resolved to pay a visit to the ancient metropolis of the world. He passed a short time at some of the principal cities of Europe, Berlin, Vienna, Florence, Naples, and Venice, and resided part of the winter 1793 at Rome, in all of

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which places his reception was extremely flattering. He was elected a member of the Academy of Berlin as well as of other learned societies. Upon his return to Britain in 1794, he took up his residence at Nidpath Castle in Tweeddale, whence he soon removed to Hallyards in Manor Water. In this agreeable retreat he spent the next fourteen years of his life, a longer period than he had ever before resided in any one place. At last, however, when his sight and his hearing had in a great measure failed, he deemed it advisable to settle in a town, where he might occasionally enjoy the conversation of intelligent friends; and his early prepossessions induced him to settle at St Andrew's. Here his strength gradually declined, but the vigour of his mind continued unimpaired as long as he lived. No man took a more lively interest in the great events which were then passing in the world, or contemplated more anxiously the consequences of the arduous struggle which his country sustained. He lived long enough to witness the triumphant issue of the contest, and, after a short illness, he died on the 22d of February 1816, in the 93d year of his age, leaving three sons and three daughters.

In the various situations which it was his lot to occupy, he had uniformly conducted himself with a dignity and decision which bespoke the elevation and force of his mind. As a military chaplain, he happily united the strict decorum of the clerical character with the unembarrassed address of a man of the world; so that he, at the same time, secured the respect of the officers, and the devoted attachment of the private soldiers. It was while accompanying the army on different expeditions, one of the first of which was an ill-conducted descent on the coast of Bretagne in 1745, that he applied his mind to the study of the art of war; and it cannot be denied that he excels particularly in the description of martial evolutions. In private life his conversation was easy and elegant, and among his intimate friends enlivened by a fascinating gaiety and refinement of humour. He was not very patient of contradiction, and rather apt to testify his contempt of assumed superiority.

His writings are,

1. *A Sermon*, preached in the Erse language to his Majesty's First Highland Regiment of Foot, commanded by Lord John Murray, at their cantonment at Camberwell, on the 18th day of December 1745. By the Rev. Mr A. F., chaplain to the said regiment, and translated by him into English, for the use of a lady of quality in Scotland, at whose desire it is now published. Lond. 1746.

2. *The Morality of Stage Plays seriously considered.* Edin. 1757.

3. *A Pamphlet on the Militia.* Lond. 1758.

4. *The History of the Proceedings in the Case of Margaret, commonly called Sister Peg.* Three editions. Lond. 1762. Another 1777.

5. *Analysis of Lectures on Mechanics.* Edin.

6. *An Essay on the History of Civil Society.* Lond. 1767. This book has passed through many editions, and has been translated into almost all the European languages. A translation into German was published at Leipsig in 1768, under the title of *Bersuch über die Geschichte der Burgerlichen Gesellschaft.* A French translation, by M. Bergier, was published in 1783.

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7. *Analysis of Pneumatics and Moral Philosophy.* A German translation, by Mr Garve of Leipsig, is said to have been well executed. Edin. 1766. 55 pages 12mo.

8. *Institutes of Moral Philosophy*, 1769. 319 pages 12mo.—Another edition, revised and corrected 1773. 294 pages. A translation of this edition into French was published at Geneva in 1775, and it had the advantage of being revised by the author.—A third edition, enlarged, was published at Edinburgh 1785. 317 pages 12mo. This elementary work has been used as a text-book in several foreign universities. A translation into the Russian language (from the German) was printed at Moscow in 1804.

9. Remarks on a pamphlet lately published by Dr Price, entitled, *Observations on the Nature of Civil Liberty, &c.* in a letter from a gentleman in the country to a member of Parliament. Lond. 1776. These remarks having been addressed to Sir Grey Cooper, Secretary of the Treasury, were printed by his direction.

10. *The History of the Progress and Termination of the Roman Republic.* 3 vols. 4to. Lond. 1783. A translation into German was printed at Leipsig in 1784. It has been translated into several other modern languages, and has passed through a number of English editions, one of which was printed at Basle in Switzerland, in 1791.

11. *Principles of Moral and Political Science*, being chiefly a retrospect of lectures delivered in the College of Edinburgh. 2 vols. 4to. Lond. 1792.

12. *Minutes of the Life and Character of Joseph Black, M. D.* 1801. (Published in the *Transactions of the Royal Society of Edinburgh.*)

13. *Biographical Sketch, or Memoir of Lieutenant-Colonel Patrick Ferguson.* Edin. 1817. (This tract, though printed, has not been published for sale.)

He has left behind him many interesting papers on the subjects which had chiefly occupied his thoughts from the time of his last academical appointment, but a great mass of letters and other valuable documents had been indiscriminately destroyed by his direction, some years before his death. (C. C. C.)

FERMANAGH, a county in Ireland, situated in the province of Ulster, having the counties of Donegal and Tyrone on the north, Tyrone and Monaghan on the east, and Cavan and Leitrim on the south and west. Its extent is about 694 square miles, or nearly 450,000 English acres, of which a considerable proportion is covered by water, and much of the rest of the surface is rugged and mountainous, particularly on the west, where it is bounded by Leitrim. Bnt it is in general better wooded than other parts of Ireland. The ash grows in the hedge rows; beeches come to a large size, and also the yew, near Lough Erne; and fir, oak, and yew are found in the bogs. Situation and Extent.

The grand feature in the natural scenery of this county is Lough Erne, which occupies about one-eighth of the surface, and stretches through its whole length, forming two large lakes, connected by a channel, like a river, six miles long. The upper lake is nine miles in length, and, at a medium, about Scenery. Lough Erne.

Fermanagh.

three broad, and the lower, which is ten miles long, varies in width from two to eight miles. It discharges itself at the north-west by a rapid current of about seven miles, forming a grand cataract, where the water is precipitated into the sea at Ballyshannon, besides a beautiful fall at Beeleck, a little higher up. This noble piece of water is for the most part closely surrounded by high grounds that run their woody promontories into the lough, and retire from it in every direction, and contains more than three hundred islands, in some instances half a mile apart. They are of various sizes, some of them having an area of several square miles. A few are adorned with gentlemen's seats and pleasure-grounds, and most of them well-wooded, the whole presenting a great variety of delightful scenery.

Monastic Ruins.

On one of these islands, called Devnish, are the ruins of several ancient buildings; a church dedicated to St Molush, and near it the saint's house, entirely roofed, and finished with cut stone, and his bed, a stone trough, which is still held in great veneration; and an abbey at a little distance, having a belfry arch of black marble, with a stair of 83 steps, near which is St Nicholas's well, to which many yet resort for relief. There is also a beautiful round tower, in a high state of preservation, 82 feet high, and 49 in circumference, said to have been built about the middle of the sixth century.

Lough Erne contains most of the fish that are found in other fresh water lakes, and is noted for its salmon and eels, particularly the latter. Four of the eel weirs near the falls of Beeleck afford a rent of L.100 each. There are several other lakes in the county, and a few streams that fall into Lough Erne, but none of them considerable.

Estates.

Estates, in this county, are large. Three proprietors, mentioned by Wakefield, have L.13,000 a year each, and other three from L.6000 to L.7000. According to the same writer, the rent, taken at twenty-five shillings the green acre, must be equal to about 14s. the English acre; but what proportion this description of land bears to the whole does not appear. The leases are now most commonly for 21 years and a life.

Farms.

In the northern part of the county, the farms are larger and more productive than in most other parts of Ulster. Oats, barley, potatoes, and flax, are the principal crops; very little wheat, clover, or turnips being cultivated, except in small patches near the towns. The high grounds are chiefly occupied in rearing cattle, and much of the better pastures with dairy stock. There are no large flocks of sheep, and their breed of this animal is of a very inferior description.

Labourers.

The price of common labour in 1809 was 1s. a-day; but labourers for hire being scarce in those parts where the farms are small, 1s. 6d. and 2s. was sometimes paid. "The poor," says Wakefield, eat wheaten bread and drink tea;" yet he elsewhere observes, that "the inhabitants are poor, and their cabins are wretched huts, with a wattled door, lined with a straw mat in the inside." Turf is the only fuel.

Manufactures.

Linen 7-8ths wide is manufactured to some extent, and there are several bleachfields which finish for sale the linens sent to England. Illicit distillation is said to be very general, much of the oats and barley grown in the county being consumed in this way.

Fermanagh ‖ Fermat.

Parishes.

Fermanagh is in the ecclesiastical province of Armagh, and is divided into eighteen parishes, of which fifteen belong to the diocese of Clogher, and three to that of Kilmore. It is computed that the Catholics exceed the Protestants in number in the proportion of three to one None of the former have property enough to entitle them to be on the grand jury.

Representation.

The other subdivisions are baronies, of which there are five to the east of Lough Erne, and three on the west. Two members are sent to Parliament from the county, and one from the borough of Enniskillen, the only town in it of any extent. The number of freeholders, a few years ago, according to Mr Wakefield, was 5000; but the three greatest proprietors, when unanimous, can always return what members they please. One of them, the Earl of Enniskillen, is also patron of the borough, which has twelve self-elected burgesses.

There is little or no gradation of rank here; the only intermediate classes between the few great proprietors and the labourers, being the small squire and the large farmer, neither of them a numerous body. A military turn has long prevailed among the inhabitants. The protestants are a fine race of people, much superior in appearance to those of any of the northern districts.

In 1790, Fermanagh was computed to contain 11,969 houses, and 71,800 inhabitants; but by the last census, the population is found to be 111,250, or at the rate of one person for about four acres.—See Young's *Tour in Ireland*,—Beaufort's *Memoir of a Map of Ireland*.—Newenham's *View of the Natural, Political, and Commercial Circumstances of Ireland*.—Wakefield's *Account of Ireland, Statistical and Political*; and the *Parochial Survey of Ireland*, Vols. I. and II. (A)

FERMAT (Peter de), equally celebrated as a restorer of ancient mathematics, and an original author of modern improvements, was born in 1590.

His public life was occupied by the active duties attached to the situation of a Counsellor of the Parliament of Toulouse, in which he was distinguished both for legal knowledge, and for strict integrity of conduct. Besides the sciences, which were the principal objects of his private studies, he was an accomplished scholar, an excellent linguist, and even a respectable poet.

His *Opera Mathematica* were published at Toulouse, in two volumes folio, 1670, and 1679; they are now become very scarce. The first contains the *Arithmetic of Diophantus*, illustrated by a commentary, and enlarged by a multitude of additional propositions. In the second we find a *Method or the Quadrature of Parabolas* of all kinds, and a *Treatise on Maxima and Minima, on Tangents, and on Centres of Gravity*; containing the same solutions of a variety of problems as were afterwards incorporated into the more extensive method of fluxions, by Newton and Leibnitz; and securing to their author, in common with Cavalleri, Roberval, Descartes, Wallis, Barrow, and Sluse, an ample share of the glory of having immediately prepared the way for the gigantic steps of those illustrious philosophers. The same volume

contains also several other treatises on *Geometric Loci*, or *Spherical Tangencies*, and on the *Rectification of Curves*, besides a restoration of *Apollonius's Plane Loci*; together with the author's correspondence, addressed to *Descartes, Pascal, Roberval, Huygens*, and others.

It was too much Fermat's custom to leave his most important propositions wholly undemonstrated; sometimes, perhaps, because he may have obtained them rather by induction than by a connected train of reasoning; and, in other cases, for the purpose of proposing them as a trial of strength to his contemporaries. The deficiency, however, has in many instances been supplied by the elaborate investigations of Euler and Lagrange, who have thought it no degradation to their refined talents, to go back a century in search of these elegant intricacies, which appeared to require further illustration. It happened not uncommonly, that the want of a more explicit statement of the grounds of his discoveries deprived Fermat, in the opinion of his rivals, of the credit justly due to him for accuracy and originality. It was thus that Descartes attempted to correct his method of maxima and minima, and could never be persuaded that Fermat's first propositions on the subject were unexceptionable. Fermat was however enabled to pursue his favourite studies with less interruption than Descartes; and the products of his labour were proportionate, as Lacroix remarks, to the opportunities that he enjoyed, as well as to the talents that he possessed.

There is a very ingenious proposition of Fermat, which deserves to be particularly noticed, on account of the discussion that it has lately excited among mathematical philosophers. He has demonstrated, that the true law of the refraction of light may be deduced from the principle, that it describes that path, by which it can arrive in the shortest possible time from any one point of its tract to another; on the supposition, however, that the velocity of light is inversely proportional to the refractive density of the medium; and the same phenomena of refraction have been shown, by Maupertuis, to be deducible, upon the opposite supposition with respect to the velocities, from the law of the minimum of action, considering the action as the product of the space described into the velocity. But the law of Fermat is actually a step in the process of nature, according to the conditions of the system to which it belongs in its original form; while that of Maupertuis is at most only an interesting commentary on the operation of an accelerating force. It was Newton that showed the necessary connection between the action of such a force and the actual law of refraction; demonstrating that all the phenomena might be derived from the effect of a constant attraction, perpendicular to the surface of the medium; and except in conjunction with such a force, the law of Maupertuis would even lead to a false result. For if we supposed a medium acting on a ray of light with two variable forces, one perpendicular to the surface, and the other parallel to it, we might easily combine them in such a manner as to obtain a constant velocity within the medium, but the refraction would be very different from that which is observed, though the law of Maupertuis would indicate no difference: so that the law must be here applied with the tacit condition, that the refractive force is perpendicular to the surface. In M. Laplace's theory of extraordinary refraction, on the contrary, the tacit condition is, that the force must *not* be perpendicular to the surface: so that this theory not only requires the gratuitous assumption of a different velocity for every different obliquity, which is made an express postulate, but also the implicit admission of the existence of a force, determinate in direction and in magnitude, by which that velocity is modified, and without which the law of Maupertuis would cease to be applicable. It may indeed be said, that the supposition of a medium exhibiting unequal velocities, and attracting the light perpendicularly, is unnatural; and that the law is the more valuable for not being applicable to it: but a mathematical equation is true even with respect to impossible quantities; and a physical law, however useful it may be, requires physical proof; and it will not be asserted that the law of Maupertuis has been or can be established, by physical evidence sufficiently extensive to render it universal.

Our author died in 1664, or the beginning of 1665, at the advanced age of 74. He left a son, Samuel de Fermat, who was a man of some learning, and published translations of several Greek authors.

((S. F.))

FICHTE (JOHN THEOPHILUS), a late eminent German metaphysician, was born at Rammenau, a village of Lusatia, on the 19th of May 1762. His father was a ribbon manufacturer, and carried on a small trade in haberdashery. A wealthy person in the neighhourhood, having been struck with the extraordinary genius which young Fichte displayed, put him to school, in order to give him an opportunity of cultivating his talents; but the boy becoming impatient of restraint, ran off, and was found sitting on the banks of the Saale, with a map, on which he was endeavouring to trace the way to America. From this period he seems to have prosecuted his studies in an extremely desultory manner; occasionally attending the lectures of the professors of Wittemberg and Leipsic, without devoting his attention exclusively to any particular science. Theology, however, appears to have been his favourite study; and this predilection is conspicuous in many of his subsequent writings, which are distinguished by a singular mixture of philosophical and religious mysticism. When he left the university, his situation was by no means enviable. He possessed no fortune to enable him to indulge in the luxury of philosophical speculation; and, in spite of his decided aversion to every kind of constraint, he was compelled, by the necessity of his circumstances, to accept of the situation of tutor in the family of a Prussian gentleman. His residence in that country enabled him to cultivate the acquaintance of the celebrated philosopher of Koningsberg, to whose judgment he submitted his first work, the *Critical Review of all Revelations*, which was published, anonymously, in 1792. In the literary journals, this production, which had attracted considerable attention, was ascribed to the pen of Kant, until the real author made himself known.

Having received fifty ducats from a Polish nobleman, in whose family he had been tutor, Fichte set

out on a course of travels through Germany and Switzerland, and afterwards married a niece of Klopstock's at Zurich. In 1793, he published the first part of his *Contributions towards rectifying the Opinions of the Public respecting the French Revolution.* This book, which is written with considerable force and originality, created a great sensation in Germany, and was violently attacked, in consequence of a new and apparently dangerous theory which the author advanced relative to the social contract. The book, however, was perused with great avidity, but the attacks to which we have alluded probably prevented him from publishing the continuation.

The reputation of Fichte was now so well established, that he was soon after appointed to the philosophical chair at Jena, as successor to Reinhold, who had been called to the university of Kiel. Here he commenced his lectures by a programme, in which he endeavoured to give an idea of the *Doctrine of Science* (*Wissenschafts-lehre*), the name by which he distinguished the principles of that system of transcendental idealism, which he afterwards more fully developed. Besides the ordinary duties of his professorship, he gave a regular course of lectures, in the form of sermons, every Sunday, in the year 1794, *on the Literary Calling*, which were numerously attended. Having established the principles of his doctrine of science, he endeavoured to extend their application to the several departments of philosophy; and, with this view, he published, in 1796, his *Fundamental Principles of the Law of Nature;* and two years afterwards, his *System of Morals.* In conjunction with Niethammer, he also published a philosophical journal, in which some articles were inserted, containing certain philosophical views of religion, which were considered by many as tending directly to atheism. Among other objectionable propositions, it was maintained that God was nothing else than the moral order of the universe; and that, to worship God as a being who could only be represented as existing in time and space, would be a species of idolatry. One of Fichte's colleagues called the attention of the Saxon minister Burgsdorf to these heretical propositions; and the consequence was, the rigorous confiscation of the work throughout the whole of Saxony. Fichte and his friend Forberg wrote an *Appeal to the Public,* and several *Apologies,* in order to exculpate themselves from the imputation of atheism. The government of Weimar behaved, on this occasion, with prudence and moderation; but the celebrated Herder, Vice-President of the Consistory, took part against Fichte. Eberhard, on the other hand, although hostile to the metaphysical system of Fichte, undertook his defence. The controversy was carried on with great violence, and excited considerable ferment throughout the whole of Germany.

In the mean time, Fichte resigned his professorship at Jena, and repaired to Berlin, where he experienced a very flattering reception. Here his time was occupied in giving private lectures, and in composing his various writings. In 1800, he published a short treatise, entitled, *The Exclusive Commercial State,* containing one of those philosophical systems of political economy from which the praise of ingenuity cannot be withheld; while, at the same time, the most cursory view of the general principles on which it is founded must be sufficient to convince us that it could never be advantageously reduced to practice.

About this period, Fichte met with a formidable rival in Schelling, who had formerly been a warm partizan of the *doctrine of science,* but who now separated from his master, and propounded a new metaphysical theory of his own, which soon acquired a large share of popularity at the German universities, especially at Jena. Fichte, indeed, endeavoured to modify his theory of the *doctrine of science,* and to present it to the world in a new and more attractive form; but he never again recovered the sway he had formerly held over the public mind. Meanwhile, his ardent wish to be again placed in an academical chair was at length gratified by M. de Hardenberg, who, in 1805, procured for him the appointment of ordinary professor of philosophy in the university of Erlangen. This appointment was accompanied with the especial favour of being permitted to pass the winter at Berlin, in order to continue his lectures there. This state of amphibious professorship, as his friends used to call it in jest, did not last long. During the summer of 1805, he delivered at Erlangen his celebrated lectures, *On the Essence of the Literary Character* (*über das Wesen des Gelehrten*). The following winter, he delivered to a numerous audience the course which he afterwards published under the title of *Guide to a Happy Life.* This was one of those publications in which he attempted to present his metaphysical doctrines to the public in all their sublimity, and, at the same time, with such clearness, as would make them intelligible to common readers.

The disasters which assailed the Prussian monarchy, in 1806, were attended with serious consequences to Fichte. Erlangen having ceased to be a Prussian university, he did not await the entry of the French into Berlin, but fled to Koningsberg, and from thence to Riga. In the summer of 1807, he delivered a conrse of philosophical lectures at Koningsberg. The peace which ensued enabled him to return to Berlin, where he pronounced his famous *Orations to the German Nation,* which were enthusiastically read and applauded throughout all Germany. When the University of Berlin was founded, he obtained, through the interest of M. de Humboldt, the situation of rector, which secured to him an honourable revenue, while his rank, as first professor of philosophy, gave him great academical influence. His health, however, had suffered considerably from the shocks he had for some time experienced, and he found it necessary to have recourse to the waters of Bohemia, from which he derived great benefit. But his wife was attacked with a nervous fever, in consequence of her attendance on the deserted sick; and although she recovered, Fichte, whose affection would not allow him to leave her for a moment, caught the infection, and died on the 29th of January 1814.

Fichte was small in stature, but stout and wellformed; his countenance was expressive of thoughtfulness and determination. In his intellectual character, genius was combined with inflexible firmness; and these qualities enabled him to surmount difficul-

ties which would have overwhelmed a less vigorous temperament. In other respects his dispositions were amiable, and his morals correct. It was in the academical chair that the genius of Fichte was manifested in its greatest splendour. It was said of him that he was born a professor; and there was, indeed, a charm in his manner of lecturing which had a powerful influence ou the minds of his pupils, several of whom we have heard talk of him with enthusiasm. His fervid and brilliant eloquence, the clearness of his reasoning, and the simplicity and correctness of his language, seemed to diffuse a magic light and colouring over the darkest and most abstruse metaphysical problems. Those who were charmed with his eloquence, were easily convinced by his reasoning, and became willing converts to his doctrines. His writings, especially those works in which his peculiar doctrines are propounded in a systematic form, are by no means so attractive as his lectures appear to have been. On the contrary, notwithstanding a constant affectation of strict and simple reasoning, his propositions are enveloped in such a degree of transcendental obscurity, as renders it extremely difficult to comprehend either the basis or the scope of that system of doctrines which he labours to establish.

Hence, it is far from being an easy matter to give an intelligible abstract of the principles of the *Doctrine of Science*, especially as we must necessarily presuppose some acquaintance, on the part of our readers, with the previous metaphysical labours of Kant. Fichte commenced his philosophical career precisely at that period when the writings of Kant had nearly obtained a paramount influence in the German schools, and when men even of superior talents thought it no mean glory to be able to comprehend and illustrate his doctrines. The Kantian theory was confessedly idealistic. Its celebrated author set out with an analysis of the cognitive faculty, endeavoured to describe its various functions, and to ascertain the scope and limits of its legitimate exercise. All our knowledge, according to the critical philosophy, must have a reference to possible experience. Of external objects, or things in themselves (*noumena*), we can have no absolute knowledge; for we can know nothing but what is perceived by the senses, and cognized (if we may be allowed the expression) by our intellectual faculties, according to the laws peculiar to our constitution. These intellectual laws, or subjective forms, tend to combine our knowledge, and to render the field of experience a comprehensible whole. As we can have no knowledge of objects in themselves, but only of their *phænomena;* neither can we have any knowledge of things beyond the sphere of our experience, because these can neither be perceived by our senses nor subjected to the laws of the understanding. All reasoning, therefore, from mere ideas must necessarily be futile, because it has no reference to any corresponding object within the limits of experience. And although we can have no absolute knowledge of objects as they really exist, yet our knowledge of them possesses a subjective reality (*i. e.* a reality with reference to the thinking subject), and may be said to correspond with the objects, because, from the nature of our intellectual constitution, we are incapable of receiving any other impression from them.

Reinhold was one of the earliest partisans of Kant, and one of the most ingenious and most popular commentators on the critical philosophy. But his talents were better adapted for explaining and illustrating the docrines of others, than for discovering new truths, or inventing any original system of his own; and although an indefatigable student of philosophy, he seems to have never arrived at any settled conviction in metaphysical matters, but to have alternately adopted and abandoned every new theory which was successively presented to his view. After having been, for some time, enthusiastically devoted to the doctrines promulgated in the *Critical Review of Pure Reason*, which he esteemed the greatest masterpiece of philosophical genius; he at length discovered that Kant had neglected to secure the foundations of the edifice he had raised, and this defect he attempted to supply by his own *Theory of the faculty of Perception. (Theorie des Vorstellungs-vermögens.)* The main proposition laid down and illustrated in this work is nothing more or less than this: We are compelled by consciousness to admit, that every perception presupposes a percipient subject and an object perceived, both of which must be distinguished from the perception to which they relate;—thus referring all our knowledge to consciousness as its ultimate principle. In the enunciation of this proposition there is nothing very new or original; but the illustration of this elementary doctrine, which, as a late reviewer of the German metaphysical theories observes, might have formed an excellent subject for a short philosophical dissertation of two or three sheets, is dilated into a work nearly as large as that to which it was intended to serve as a mere introduction; nor is the unnecessary length of the treatise in any measure compensated by the importance of the truths developed, or the ingenuity displayed in the research.

With greater talents and consistency, Fichte, who announced himself as a strict Kantian, attempted to solve the same problem, and to develope a system, which, by deducing all our knowledge from one simple principle, should give unity and stability to the critical theory. In his *Doctrine of Science* (*Wissenschaftslehre*), accordingly, he derives all our knowledge from the original act of the thinking subject in reflecting upon itself. *I am I*, (which he expresses by the formula A=A), or the absolute position of the I by the I, is in itself the certain principle of all philosophy and of all our knowledge. But the creative energy of the I, in the course of this reflective process, goes still farther. By its own act, also, the I places the *not—I* (objects) as opposed to itself. In reflecting upon itself, as the absolutely active principle, it finds itself either determined by, or determining the *not—I*. In the former case, it appears as the *intelligent I;* in the latter, as the *absolutely free, practical I*. Hence the distinction between theoretical and practical philosophy. The idea, then, which pervades the whole theory of Fichte is this: The I, or the thinking subject, is the absolutely active principle, which *constructs* the consciousness, and produces all that exists, by position, contra-po-

Fichte. sition, and juxta-position. The whole universe, in short, is the product of the I, or thinking subject.

We have thus endeavoured to give a very concise sketch of a theory, which we shall not think of pursuing through its various ramifications, as we should despair of making it intelligible to our readers by any length of exposition. Fichte has been praised by his countrymen for his logical and consistent reasoning; but to us it appears that his theory proceeds entirely upon arbitrary assumptions, resting upon no solid foundation. That he displays considerable ingenuity in the developement of his ideas we are willing to admit; but we are quite at a loss to perceive the merit of the theory he has advanced, when considered as a system of philosophical truths. The parade of scientific deduction which his reasoning exhibits may impose upon the incautious student; but a careful examination will undoubtedly convince him, that the whole is a mere tissue of empty notions, drawn from arbitrary and assumed principles.

In attempting to apply the principles of his doctrine of science to the theory of morals and the law of nature, Fichte exhibited many original and paradoxical opinions, along with some very just and ingenious philosophical observations. In his later writings he considerably modified his original theory of the doctrine of science, and produced a system of philosophical and religious mysticism, which appears to have given birth to the transcendental idealism of Schelling; an author who seems to have carried the extravagance of speculative reasoning to its utmost limits.

The following is a list of the works of Fichte:

1. *Versuch einer Kritik aller Offenbarung.* (Critical Review of all Revelation). Koningsberg, 1792, 1793. 8vo.

2. *Ueber den Begriff der Wissenschaftslehre.* (On the notion of a Doctrine of Science). Jena, 1794. 8vo.

3. *Grundlage der gesammten Wissenschaftslehre.* (Foundation of the whole Doctrine of Science). *Ibid.* 1794. 8vo.

4. *Grundriss des eigenthümlichen der Wissenschaftslehre.* (Sketch of the peculiarity of the Doctrine of Science). *Ibid.* 1795.

5. *Vorlesungen ueber die Bestimmung des Gelehrten.* (Lectures on the Literary Calling.) Jena, 1794.

6. *System der Sittenlehre.* (System of the Doctrine of Morals.) Jena and Leipsic, 1795.

7. *Beyträge zur Berichtigung der Urtheile des Publicums ueber die Französische Revolution.* (Materials for Rectifying the Opinions of the Public respecting the French Revolution).

8. *Grundlage des Naturrechts.* (Foundation of the Law of Nature). Jena, 1796, 1797. 2 Vols. 8vo.

9. *Appellation an das Publicum ueber die ihm beygemessenen atheistischen Aeusserungen.* (Appeal to the Public respecting the Atheistical expressions imputed to him). Jena and Leipsic, 1799.

10. *Ueber die Bestimmung des Menschen.* (On the Destiny of Man).

11. *Der geschlossene Handelsstaat.* (The exclusive Commercial State).

12. *Sonnenklarer Bericht an das grössere Publicum ueber das eigentliche Wesen der neuesten Philosophie.* (Luminous Report to the greater public on the peculiar Character of the Modern Philosophy). Berlin, 1801.

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13. *Wissenschaftslehre.* (Doctrine of Science). Tübingen, 1802. 8vo.

14. *Vorlesungen ueber das Wesen der Gelehrten.* (Lectures on the Literary Character). Berlin, 1806.

15. *Die Grundzuge des gegenwärtigen Zeitalters.* (The Characteristics of the present age). *Ibid.* 1806.

16. *Anweisung zum seligen Leben.* (Guide to a Happy Life). *Ibid.* 1806.

17. *Reden an die Deutsche Nation.* (Discourses to the German nation). *Ibid.* 1806.

18. *Die Wissenschaftslehre in ihrem allgemeinsten Umrisse dargestellt.* (The Doctrine of Science exhibited in its most general outline). *Ibid.* 1810

19. *Freidrich Nicolai's Leben und Sonderbare Meinungen, herausgegeben von Schlegel.* (Life and singular opinions of Frederic Nicolai, edited by Schlegel.) Tübingen, 1801.

20. *Antwortschrieben an K. L. Reinhold, auf dessen Beyträge zur leichtern Uebersicht des Zastandes der Philoscphie,* &c. (Answer to K. L. Reinhold, on his Materials for acquiring a more easy view of the State of Philosophy, &c.) *Ibid,* 1801.

21. *Ueber die einzig mögliche Störung der academischen Freyheit.* (On the only possible disturbance of Academical Freedom.) Berlin, 1812.

22. *Ueber den Begriff des wahrhaften Kriegs, in Bezug auf den Kreig in Jahre* 1813. (On the notion of real war, with reference to the war in 1813.) Tübingen, 1815.

Fichte is also the author of several essays in periodical publications, and particularly in a philosophical journal edited by himself, with the assistance of Niethammer.

Those who are desirous of obtaining more minute information respecting Fichte's philosophical theory, may consult the following works: Tennemann's *Grundriss der Geschichte der Philosophie;* Degerando, *Histoire Comparée,* &c. W. T. Krug, *Briefe ueber die Wissenschaftslehre.* F. W. J. Schelling, *Darlegung des wahren Verhältnisses der Naturphilosophie zu der verbesserten Fichtischen Lehre.* J. Fries, *Reinhold, Fichte und Schelling.* C. F. Bachmann, *Ueber die Philosophie meiner Zeit.* Ancillon, *Essai sur le premier probleme de la philosophie;* and *Essai sur l'existence et sur les derniers systemes de metaphysique qui ont paru en Allemagne.* (H.)

FIFESHIRE is bounded by the river Tay on the north, the German Ocean on the east, the Frith of Forth on the south, and on the west by the counties of Kinross, Perth, and Clackmannan. Its medium length, from east to west, is about 36 miles, and its breadth, from north to south, 14; so that its area is 504 square miles, or 322,560 English acres. About four-fifths of this may be considered as fit for cultivation, and the remainder consists of hills, mosses, and moors, with roads and plantations. Situation and Extent.

This county, which is situated on the south-east corner of the middle peninsula of Scotland, is, for the most part, composed of low lying grounds, though Surface and Natural Divisions.

Fifeshire. little of it is flat or level. There is a pleasing variety of hill and valley in every direction. It is divided into two parts by a tract of high ground, which comprehends the Lomond Hills on the west, and from thence stretches eastward almost in a direct line till it approach within a few miles of the sea. The highest of these hills is West Lomond, which is 1721 feet above the level of the sea; Largo Law, on the east, is 952, and Kelly Law 810. The rivers Eden and Leven throw it into three divisions, the northern, between the Eden and the Tay, the middle, between the Eden and the Leven, and the southern, between the Leven and the Frith of Forth. Along the Frith of Forth, from the eastern to the western boundary of the county, the land rises gently, and has no great elevation above the sea. The soil here is generally very fertile, for a breadth of about three miles, a deep rich loam, or clay, and sometimes loam with gravel. Beyond this, a cold poor clay prevails, lying, for the most part, on sandstone, which extends northward to the high ground on the south of the Eden. In this district there are extensive tracts of moss and moor. Farther north, on both sides of the Eden, and from the mouth of that river westward to Perthshire, there is a rich valley called the *How* of Fife, which spreads out as it approaches the sea into a considerable tract of very productive land. A range of high grounds, a continuation of the Ochills, intervenes between this valley and the Tay on the north; yet as the soil lies upon whinstone it is in many places fertile, and often deeper and richer on the acclivities than at their bottom.

Climate. As no part of Fifeshire is nine miles from the sea, the climate is mild and the harvests early. Snow seldom lies long. Yet from the direction of its hills, from east to west, it is much exposed to the easterly winds, which often check vegetation in the spring months; and hoar frosts are not unfrequent so late as the middle of June. The heaviest rains are from the south-west, the south-east, and the north-east, and the winds from the two last points bring the greatest falls of snow. The driest and most steady weather comes from the west, north-west, and east.

Waters. The only streams of any note are the *Leven* and the *Eden*. The former, which issues from Loch Leven, in Kinross-shire, flows eastward through a beautiful strath, by Leslie, Balgonie, and Balfour, and, after a course of about twelve miles, during which it receives the Lothrie and the Orr, falls into the Frith of Forth at the town of Leven. From the declivity of its channel, it is well fitted for impelling machinery, and accordingly a great number of mills have been erected on its banks. It abounds in salmon and sea trout, and where it falls into the sea, there is a considerable salmon-fishery. The Eden is formed by the confluence of several small streams in the parish of Strathmiglo on the west, near the boundary with Kinross-shire, and, winding slowly through a level valley, and sometimes overflowing its banks, passes the town of Cupar, and loses itself in the German Ocean, about eighteen miles from its source. It contains trout, pike, and eels, and has also a salmon-fishing where it discharges itself into the sea. The Gair Bridge over this river, consisting of six arches, was built in the beginning of the fifteenth century. There is a number of lochs, none of them large, but some of them very beautiful, such as those at Lindores, Kilconquhar, Kinghorn, Lochgellie, Camilla, Lochfittie, and Otterston.

Coal. The southern part of Fifeshire, from the Forth almost to the Eden, abounds in coal of all the kinds common in Scotland. Along the Frith of Forth the strata generally dip to the east and south-east, but are cut off before they reach the higher ground, not extending above two or three miles from the shore. In this district, proceeding from west to east, coal is found in the parishes of Torryburn, Abbotshall, Kirkaldy, Dysart, Wemyss, Scoonie, Largo, and Pittenweem. The coal-works in Dysart and Wemyss are very considerable; in the former parish there is a bed eighteen feet thick, which is said to have been wrought more than 300 years ago, and it is remarkable for having been frequently on fire. Beyond this tract to the north, the coal and all the other strata commonly incline to the north or north-east. The most considerable collieries in this quarter are in the parishes of Dunfermline, Dalgety, Auchterderran, Leslie, and Markinch; the last of which only resembles the metals on the sea-coast in its general bearing. Limestone is in great abundance along the whole of this tract. Limestone. In the Saline hills, still farther to the north, coal and lime are found in various places; there is a considerable coal-work at Keltie, in the parish of Beith, on the borders of Kinross-shire; but from the south side of the vale of Eden northward to the Tay, there is no coal nor any appearance of the metals that usually accompany it, except perhaps near Newburgh, where limestone occurs. From a charter, dated in March 1291, it would appear that coal has been wrought in this county for more than five centuries. William de Oberville there grants liberty to the convent of Dunfermline to open a coal pit in his lands of Pittnycrieff. But this is not, as has been alleged, the first instance of a Scottish charter containing a right to work coal; for Mr Chalmers alludes to one dated in 1284-5, from which it may be inferred, that coal was wrought on the lands of Tranent before that period. The greatest lime-works in Scotland are at Charlestown, on the Forth, belonging to the Earl of Elgin; about 100,000 tons are raised here annually, part of which is sold as it comes from the quarry, and 12,000 tons of coals are employed in calcining the remainder on the spot. Ironstone, of a good quality, is found in the parishes of Dysart and Dunfermline, and sandstone in almost every part of the coal district. Lead has been wrought in the Lomond hills. Marl is met with occasionally, and clay fit for bricks and tiles; at Durie coal-works, a species of clay has been discovered proper for fire-bricks. Stones, somewhat resembling the precious garnet, are found in considerable numbers at Elie, and known by the name of *Elie rubies*.

Estates. Most of this county is divided into estates of a moderate size; there are a greater number, indeed, above L.500 Scots of valuation than in any other county in Scotland; but of the 638 estates which it contained in 1811, 491 were below that amount. In the same year the number of freeholders, entitled to vote for a member for the county, was 207. If

Fifeshire. we may judge from the valuation, which is still the rule for the payment of cess and other taxes, Fifeshire must have been the most valuable of all the Scottish counties about the middle of the seventeenth century; the amount is L.363,192, 3s. $7\frac{2}{12}$d. Scots, almost a tenth part of the whole valuation of Scotland. Somewhat more than a third of this belongs to estates held under entail, and there are twenty-nine estates belonging to corporate bodies, which, like the former, cannot be brought to market. The rental of the lands, in 1811, was L. 335,290, 14s. 6d. Sterling, or almost a guinea an acre over the whole, and of the houses L. 38,756, 1s. 6d. On the Lomond hills, there is a common of about 4000 acres, one of the very few now to be found in Scotland, which once belonged to the palace of Falkland, and afterwards became the property of the surrounding heritors; yet it was thought not to come under the Scots statute, authorizing the division of commons, which excepts those belonging to the king and to royal burghs, and is still in its natural state; but having been divided very lately, it will soon be rendered much more valuable. There is a great number of elegant seats in the county, of which ten belong to eight peers, and seven to baronets, besides more than seventy to other proprietors. According to the author of the Agricultural Survey, published in 1800, upwards of half a million had been expended on buildings during the twenty-four years preceding. Considerable tracts have been planted within these few years; yet there is still a want of shelter in many parts, and the county at large is by no means well wooded.

Rental.

Seats.

Ancient Buildings.

Fifeshire is also distinguished for its buildings of an earlier age. Among the religious houses, the most remarkable are the ruins of St Regulus's chapel and tower at St Andrews, said to have been built in the fourth century; the cathedral at the same place, founded in 1161; the Abbey of Dunfermline, remarkable for its being a royal cemetery, where the remains of Robert Bruce were lately discovered, and re-interred with becoming solemnity, the Abbeys of Lindores, Inchcolm, Balmerino, and the priory of Pittenweem: and among the secular, the palace of Falkland, originally a seat of the Macduffs, Earls of Fife, and afterwards a royal residence; the castle of St Andrews, on the north side of the town, where Beaton was put to death by Norman Leslie in 1545; the castles of Rosyth, Lochorr, Ravenscraig, Easter Wemyss, Balgonie, and Scotstarvet; and Craighall, the seat of Sir Thomas Hope, advocate to Charles I., from whom are descended the principal families of that name in Scotland. Near Easter Wemyss there is a number of caves, most of them 100 feet above high-water mark, and several of them of considerable extent; one of them is visited by young people, with lights, on the first Monday of January old style, but the origin or object of the practice is unknown. A bulwark of stone, called *Danes-dyke*, may yet be traced across the east point of Fife.

Caves.

Farms.

The farms of this country are in general of a moderate size; few of them are what may be called large, the greater number are small, and the average perhaps about 150 acres. But there are many possessions from 50 down to 8 or 10 acres, some of them occupied by their proprietors, and others by manufacturers, tradesmen, and mechanics. In all the new leases the rent is made payable in money, though in a few instances the amount may depend upon the price of grain, and vary from year to year accordingly. The common endurance of a lease here, as throughout Scotland, is nineteen years. It was usual fomerly to add the life of the tenant, under an idea that he would always hope to live a little longer, and thus continue to improve his farm instead of exhausting it, as is too commonly done towards the end of a lease, when it is for a number of years certain; but this expectation has seldom been realized, and the practice of adding the life has therefore been discontinued. Farm-buildings present a great variety in regard to their materials and construction as well as their size; but such as have been recently erected are not unsuitable to the extent of the farms; and the cottages are generally better now than many of the best farm-houses were fifty years ago. More than a third of the county is completely and substantially enclosed with dry-stone walls or thorn hedges, chiefly the latter; the rest is either altogether open, or so badly fenced as to afford neither security nor shelter; the hedges, in too many instances, being full of gaps, and overgrown with weeds.

Agriculture.

Of the agriculture of Fifeshire, it is only necessary to observe, that all the farm-crops common in the south of Scotland are cultivated here upon a large scale, for the greater part according to the most approved system, and with great success; and that this is one of the few Scottish counties where flax is grown to some extent as a farmer's crop; though it is by no means a favourite with landlords, who, in some instances, have prohibited the tenants from sowing more than one acre in a-year. The cattle of this county have long been in high repute, both as fattening and dairy stock. The prevailing colour is black; horns small, white, turned up at the points; bone small in proportion to the carcase; weighing, when fat, from three to four years' old, from 40 to 60 stone. The cows, when well fed, yield from 10 to 14 Scots pints of milk daily (nearly half as many English wine gallons) during the best of the grass season, and continue long in milk; yet the dairy is here but a secondary object. The oxen were formerly much employed in labour, and were in request for this purpose for the counties along the north-east coast, but they are now very seldom to be seen at work. There are very few flocks of sheep. The horses are much the same as are found in all the lowlands of Scotland. Pigeons are very numerous, there being upwards of 300 pigeon cots; the havoc they make among the grain has long been matter of complaint with the farmers, and they have been upon the decrease of late.

Cattle.

Manufactures.

The staple manufacture of this county is linen. Dunfermline has long been famous for its damasks and diapers. Checks, ticks, osnaburgs, and other fabrics, are made in several towns. In 1812, 4,500,000 yards of linen cloth were stamped, of the value of L. 280,000; and in 1800, 600,000 yards of plain linen were supposed to be made by private families for their own use, which were not stamped. The number of hands employed in all the branches of

Fifeshire.

this manufacture in 1800 was computed to be 23,192. Flax is spun into yarn almost in every family, and, since 1793, a number of mills have been erected which supply yarn for the coarser fabrics. The other manufactures are spirits, at four distilleries, one of which works for the English market; shipbuilding at Dysart, Kirkaldy, Wemyss, and Anstruther; salt at the two former places and other towns; leather at Kirkaldy, Cupar, Auchtermuchty, and Falkland; and there are breweries in every town, and most of the villages. At Cupar, Kirkaldy, and Leven, bricks and tiles are made to a large amount; and vitriol or sulphuric acid at Burntisland. Haddocks, cod, and in their season herrings, are caught in considerable quantities on the coast, and part of the salmon fishings on the Tay belong to this county.

Commerce.

Though the situation of Fifeshire, almost surrounded by the sea, with several harbours, which, at a small expence, might be made to admit vessels of great burden, is particularly favourable for commerce, yet it makes no figure in that department. Customhouses are established at Kirkaldy and Anstruther, the former of which embraces all the coast from Aberdour to Largo, and the latter from Largo to St Andrews. The trade on the north side of the county is under the inspection of the customhouses of Dundee and Perth, and that from Aberdour westward belongs to the customhouse of Borrowstownness. In 1800, 142 vessels, carrying 13,513 tons, and navigated by 883 seamen, were under the two customhouses within the county, and about half the number of each was supposed to be under those out of it. These vessels are partly employed in foreign trade with Russia and the ports on the Baltic, but chiefly in the coasting trade. The exports are the manufactures already mentioned, with coal, lime, and grain of all sorts; and the imports from foreign parts, timber, bark, hides, and tallow, flax and flax-seed, hemp, tar, iron, &c. and coastwise, groceries, and other articles required for home consumption.

Royal Burghs.

Fifeshire contains seventeen royal burghs, four of which were excused from sending representatives to Parliament, from their inability to defray the necessary expence, but still retain all their other privileges. The thirteen which have a share in the election of the members for the Scottish burghs are Burntisland, Kinghorn, Kirkaldy, and Dysart, which form one district; and Anstruther, East and West, Pittenweem, Kilrenny, and Crail, another. The remaining four are joined with burghs belonging to other counties; Cupar and St Andrews, with Dundee, Perth, and Forfar; and Dunfermline and Inverkeithing, with Stirling, Culross, and Queensferry. Fifeshire thus sends three members to Parliament, one for the county, and two for its burghs; besides, that the latter have a share in the election of two members more. None of these towns are now considerable, Dunfermline excepted, which is a thriving place, with a population, in 1811, of 11,649. That of Cupar, the county town, and St Andrews, the two next in importance, is about 4700, Kirkaldy 3747, and all the others less than 2000. Packets and ferry-boats ply regularly across the Forth from several of these places; but the great thoroughfares are between Leith and Kinghorn, or Pettycur, and between Queensferry and Inverkeithing or the North Ferry.

Parishes.

Fifeshire is divided into sixty-one parishes belonging to the four presbyteries of St Andrews, Cupar, Kirkaldy, and Dunfermline, which compose the synod of Fife; but there are four parishes besides in the presbytery of Dunfermline, and one in the presbytery of Kirkaldy, which are not situated in this county. The population in 1800 and 1811 will be seen from the following abstract. See Sibbald's *History of Fife and Kinross.*—Thomson's *General View of the Agriculture of the County of Fife.*—*The Beauties of Scotland,* Vol. IV.—*The General Report of Scotland,* 1814.—And Playfair's *Description of Scotland,* 1819. (A.)

Population

1800.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
17,065	22,298	766	42,952	50,791	9651	17,300	59,866	93,743

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
17,518	26,352	137	45,968	55,304	5073	15,564	5,715	101,272

Filangieri.

FILANGIERI (GAETAN), celebrated for his various works on political economy and legislation, was born at Naples, on the 18th August 1752. He was the third son of Cesar Prince of Anianello, by Marianne Montalto, daughter of the Duke of Fragnito. His family was ancient, and rose to distinction at the first establishment of the Neapolitan monarchy. Angenio, its founder, was the son of one of those brave Normans who landed in Italy about the beginning of the eleventh century, and accompanying Count Roger in all his military expeditions, he received from him ample domains as the reward of his exploits. His descendants were allowed to take the honourable title of Filii Angerii, and hence the name Filangieri. Gaetan from his infancy was destined to the profession of arms; when he was seven years of age, he was enrolled in one of the royal regiments, and he commenced actual service at the age of fourteen. His education was at first neglected from a misconception of his character, which was supposed to be averse from all literary or speculative pursuits. The injudicious methods adopted at that time in the teaching of Latin had, it appears, disgusted him, and alienated his mind from the study of this language; and hence an impression had been hastily taken up of his general unfitness for all literary exercises. A lucky accident, however, not only removed this apprehension, but showed that his former impatience of the modes of tuition then in use, arose from the clearness and vigour of his judgment. It happened that his brother's preceptor had one day mistaken the solution of some geometrical problem. Gaetan immediately perceived the source of this error, which he demonstrated to the master. This incident, apparently trivial, determined his future destiny. Encouraged by his success he quitted the military service, and determined to follow his natural taste for science and philosophy. So diligent was he in repairing the defects of his education, that at twenty years of age he had acquired a knowledge of Greek and Latin, of ancient and modern history, of the great principles both of civil and of public law, and was besides well initiated in mathematical science. Although his genius inclined him solely to the study of legislation and policy, he sacrificed his views to the wishes of his friends, and entered on the profession of the law, which was then the certain road both to honour and fortune. His success was rapid both from his eloquence and his extensive knowledge; and, about this period, a circumstance happened which greatly conduced to his celebrity. Great abuses prevailed at Naples in the administration of justice from the uncertainty of the law, which gave rise to constant misconceptions, and almost always to arbitrary judgments. By a wise ordinance of the king, passed in the year 1774, at the suggestion of the minister, Tanucci, those abuses were reformed, the law was restored to its proper authority, its judgments were freed from the control of precedents, and the judges were ordained, in every case, to publish the grounds of their decisions. Although this reform was generally applauded, it excited the murmurs of the bar. Filangieri now became the advocate of the court, and published a defence of the royal decree, founded on the most enlarged views of equity and reason. The extensive knowledge and matured judgment displayed in this performance attracted the attention of the ministers, and Filangieri was encouraged to pursue the course in which he had already acquired such distinction. Through the influence of his uncle, the Archbishop of Palermo, he was, in 1777, placed in an honourable office at court, and was almost at the same time named officer of the royal corps of marine volunteers, who were more particularly attached to the king's person. His abode at court neither broke in upon his regular habits of life, nor upon the course of his studies; nor did he allow it to interrupt the composition of the great work on legislation and government in which he was engaged, and to which for several years past he had devoted all his inquiries. About the commencement of the eighteenth century, a great school of philosophy was formed at Naples, in which the principles of the civil law, of the law of nations, and of legislation, were established on the solid and comprehensive basis of general expediency. From this school numerous works of celebrity have proceeded, among others the great work of Beccaria, which, though confined to one branch of legislation, contains general principles which are of universal application. There was still wanting, however, a general treatise on legislation, for the purpose of examining it in all its relations, and of laying down some common and universal principles of equity and expediency as its only true basis; and it was to this important undertaking that Filangieri's philosophical mind was directed. His subject he proposed to divide into seven books. The first, on the general rules of legislation, and the second on political laws, and on those laws also which are connected with the general structure of society, appeared in 1780 at Naples; and such was its popularity, that not only in Italy, but throughout Europe at large, the author was ranked among the most celebrated writers on public law. According to his theory, the goodness of laws is either absolute or relative. It is absolute, when they are agreeable to those great and universal principles of equity and expediency which are obligatory on man under every diversity of country, climate, government, or manners; it is relative, according as the laws agree with the nature of the government, with the genius and character of the people, with the climate, with the fertility or sterility of the soil, with the physical circumstances of the country, with the religion of the inhabitants, and the degree of civilization to which they have advanced. In his second book, which treats of political laws, and of those laws also which are connected with the general economy of society, he examines two points, namely, the state of population and of wealth. With respect to the first point, the great question which he considers is, whether Europe is as populous as it might be. This question he resolves in the negative, and he proceeds to explain the causes of this deficient population. According to his hypothesis, the state of agriculture affords in every country the surest evidence as to the state of the population; and the backwardness of agriculture in most parts of Europe sufficiently indicates that the population is

Filangieri. deficient; and hence he infers the defective state of European legislation on these two capital points. The great obstacles to the improvement of agriculture, and, consequently, to the increase of population, he considers to be, 1*st*, The small number of proprietors and the great number of non-proprietors. 2*dly*, Too many large properties, and too few small properties. 3*dly*, The exorbitant and inalienable possessions of the church in several states. 4*thly*, The excess of the public imposts, and the violent modes of levying them. 5*thly*, To these he adds other causes of less importance, such as the state of most of the regular troops of the European states; also public corruption and the dissoluteness of private morals. The progress of agriculture, the great source of wealth as well as of population, may also be obstructed by a bad political administration, by bad laws, or by those causes which occasion a great influx of inhabitants to the respective capitals of the different states. It belongs to a pure system of legislation to remove some of those obstacles, and to counterbalance such others as are inevitable, by suitable encouragements. Having discussed those momentous questions, he enters into a comprehensive survey of the other sources of riches, namely,—arts, manufactures, and commerce,—and points out how they may be obstructed by a faulty legislation, and, at the same time, the means by which these might be removed. In order fully to comprehend the merits of these performances, we must consider that all the faults which the author reprehends were committed by his own government; a circumstance which imposed on him the delicate task of stating obnoxious truths with freedom and boldness, and, at the same time, without offence. So well, however, did he appreciate the views of those whom it was his wish to enlighten, that he was immediately promoted by the king to the Commandery in the Royal Order of Constantia. In 1783, he married a Hungarian lady of noble birth, who was entrusted with the education of the second daughter of the king, and who joined to outward attractions the gift of a sound judgment and an agreeable disposition. That he might the more freely enjoy domestic happiness, and, at the same time, have leisure for the composition of his work, on which he became every day more intent, he resigned, with the consent of the king, all his military employments and his office at court, and retired to a country seat about twenty miles from Naples. In the same year, he published his third book, relating entirely to the principles of criminal jurisprudence. In these discussions he maintains the same tone of decision and independence as before. Abuses are freely pointed out, and the defects of the penal code, and in the forms of criminal procedure, are fairly exposed. In thus pointing out those defects in the domestic administration of his government, Filangieri excited the hatred of an interested and powerful class; and a proposition which he made in his third book, for the reformation of abuses in the Roman Church, drew down upon his work the censure of some of the ecclesiastical tribunals. In 1785, however, he published the 5th, 6th, and 7th volumes of his work, which comprehended his fourth book. These were devoted to the consideration of education, morals, and public instruction; and though, on these important points, we may be occasionally disposed to question his views, we must nevertheless admire his mild and philosophical spirit still opposed to every excess, his extensive knowledge, and his happy talent of arranging and combining it for the illustration of his argument; his animated, flowing, and perspicuous style; and, above all, that rectitude and philanthropy which is diffused over all his reasonings. His fifth book was soon after published, which treated of the laws relative to religion. His health was now considerably impaired, owing to an excess of application, so that the remainder of his work advanced but slowly; and other interruptions soon followed. In the year 1787, he was called by the new king, Ferdinand IV., to the supreme Council of Finance. He returned to Naples, and from that time was wholly engrossed with the important business of this office. His health, already impaired, was soon completely broken by such severe and active application, and several domestic misfortunes operating upon a mind of deep sensibility, threw him at last into a state of melancholy. He finally retired from all business into the country, where he soon after fell seriously ill, and on the 21st July 1788 he expired. Before his death he had finished the 8th volume of his work, containing the first part of the 5th book, in which he treats of the different systems of religion which preceded Christianity. Of the second part of the same book he had only made a rude sketch, in which were noted down the principal subjects of discussion; namely, the advantages of Christianity and the dangers of superstition; the inconveniences of mixing spiritual with temporal concerns; the excessive riches of the clergy, and the immense increase of their power. He was also to examine the foundation of ecclesiastical rights, and to present, in a new system of legislation, a remedy for the abuses which he pointed out. A chapter on toleration would have terminated this book. In his 6th and last book he proposed to treat of the laws relative to property, and of the nature of the paternal power and the government of families. He had also other important works in contemplation when his course was terminated by death. This eminent person, along with the rarest gifts of genius, was endowed by nature with the additional advantage of a most imposing presence. His manners were graceful and dignified. His countenance bore the traces of habitual reflection, and of deep sensibility, mingled with an expression of soft melancholy. In private life nothing could exceed the simplicity of his character, and the animation and interest of his conversation.—See *La Scienza della Legislazione*. 5 Tom. 8vo. Livour. 1807. This is the last Italian edition of Filangieri's great work. There is a French translation in 7 vols. 8vo, published at Paris in 1798, from the Neapolitan edition of 1784. The *two first Books* have been translated into English, under the title of *The Science of Legislation*, from the Italian of Filangieri, and published in 2 vols. 8vo, Lond. 1806. (o.)

FISHERIES.

Fisheries.

In the body of the *Encyclopædia* will be found some details on the British fisheries, the laws by which they are regulated, the various kinds of encouragement they have met with from the government, and private individuals, and some account of their state up to the period when that article was written. It is now proposed to take a more general and extended view of this important branch of employment, to point out what is conceived to be the real causes which have impeded its progress, and to give a general sketch of the present state both of the home and foreign fisheries.

HOME FISHERIES.

Alleged neglect of by Great Britain.

The alleged neglect of the fisheries, on the part of Great Britain, has been the subject of unqualified censure, from a very early period of her naval and maritime history, and reproaches have been dealt out with no sparing hand, not only for having disregarded those advantages, so liberally bestowed by Nature along the extensive coasts of her sea-girt islands, in supplying a wholesome and nutritious article of food for the sustenance of an abundant population; but also, for suffering the nations of the Continent to resort to her very bays and harbours without molestation, and even purchasing from them that very property which she was either too ignorant or too indolent to procure by her own sagacity or industry; though neither of them required to be exerted in any extraordinary degree, in the pursuit of this occupation. "The fishery," says Sir William Monson, "needs no discovery; the experience of our neighbours having found it out, and practised it since the year 1307, to their immeasurable wealth and our shame."

Contrasted with the attention of the Dutch.

Thus also, Sir John Boroughs complains in his *Sovereignty of the British Seas*, that "it maketh much to the ignominy and shame of our English nation, that God and Nature, offering us so great a treasure, even at our own doors, we do, notwithstanding, neglect the benefit thereof, and by paying money to strangers for the fish of our own seas, impoverish ourselves to make them rich;" and as a contrast to our supposed indolence and indifference, he draws a lively picture of the bustle and activity which the herring fishery of Holland communicated to the various tradesmen and artificers, labourers, salters, packers, &c. and of the multitude of poor women and children to whom it afforded employment. In a little pamphlet, under the title of *England's Path to Wealth and Honour*, in a dialogue between an Englishman and a Dutchman, the whole alphabet is ingeniously brought to bear, in regular order, on the trades and occupations connected with the herring fishery of Holland. The importance, indeed, of this branch of national industry in that country is pretty obvious from the following abstract of the population of the States-General taken in 1669.

Persons employed as fishermen, and in equipping fishermen with their ships, boats, tackle, conveying of salt, &c.	450,000
Persons employed in the navigation of ships in the foreign trade, wholly independent of the trade connected with the fisheries,	250,000
Persons employed as manufacturers, shipwrights, handicraft trades, dealers in those manufactures,	650,000
Persons employed in agriculture, inland fishing, daily labourers,	200,000
Inhabitants in general not included in any of the above,	650,000
Idle gentry, without calling, statesmen, officers, soldiers, beggars, &c. supported by the labour of the rest,	200,000
Making a total of	2,400,000

Importance of the Herring Fishery to the Dutch.

From which it will appear not at all improbable that the pensionary De Witt did not exaggerate when he stated, that every fifth man earned his subsistence by the sea fishery; that Holland derived her main support from it; and that the herring-fishery ought to be considered as the right arm of the republic. It is further asserted that, when in the zenith of her prosperity, not less than 3000 boats, of various kinds, were employed in the bays and islets of her own coasts; and that, in those of Great Britain, they had 800 vessels, from 60 to 150 tons burden, occupied generally in the cod and ling fishery, besides others employed in carrying out salt to them, and returning with cured fish; that from Bouganess to the mouth of the Thames, they had a fleet of 1600 busses actively engaged in the herring fishery, each of which might be said to give employment to three others in the importation of foreign salt—in carrying the salt to fishing ships, and returning with cured fish—and in the exportation of that fish to a foreign market;—making, thus, the total number of shipping engaged in, and connected with, the herring fishery alone, to amount to 6400 vessels, calculated to give employment to 112,000 mariners and fishermen. By the same authority we are told that Holland, at that time, could boast of 10,000 sail of shipping, and 168,000 mariners; "although the country itself affords them neither materials, or victual, or merchandise, to be accounted of towards their setting forth." Indeed, the Dutch themselves made no scruple of avowing, that the wealth, strength, and prosperity of the United Provinces were derived from the herring fishery; the importance of which was strongly marked by an observation in common use among them, that "the foundation of Amsterdam was laid on herring-bones."

No wonder, then, that the example of the Dutch should be held forth as a reproach to England; and we find, accordingly, that it was so considered by

Fisheries.

some of the ablest writers of former times, Sir Walter Raleigh, Sir William Monson, Sir William Petty, Sir Roger L'Estrange, and others. It would seem, however, to have altogether escaped these writers, that the situation and circumstances of the Dutch were entirely different from those in which the people of the British islands were placed. Those provinces of Holland, where the fisheries flourished, had few or no resources but those which the waters afforded them; they grew no corn; they had no superabundance of food for the rearing of cattle; they had few or no manufactures; whereas Great Britain had all, and abounded in most of them. The Dutch having, therefore, neither food nor raiment but what they must purchase from foreign nations, and the only article they had to offer in return being the products of the seas, it was necessary for them to expend their whole industry in availing themselves of those products, in order to exchange them for others of the land. It was not, therefore, from choice, but absolute necessity, that the Hollanders braved the dangers, and submitted to the fatigues, of the deep sea fishery. It was their whole resource, and afforded them the only scope for turning their industry to profit; and it must be allowed that, by an extraordinary degree of patience, and of perseverance, and, by long practice, they succeeded in bringing to a state of unrivalled perfection the mode of catching and the method of cure, which other nations, less experienced, and less interested, had not arrived at; though it is now known, and admitted, that there is no great art nor mystery in the craft,—nothing that British fishermen could not then have, and, in point of fact, nothing which they have not of late years, accomplished, in as perfect a manner as the Dutch.

Circumstances different between England and Holland.

But the case was different with regard to Great Britain. She laboured under none of the disadvantages, and felt none of the necessities, which pressed upon Holland. Her capital was employed in foreign commerce, in the improvement of her agriculture, and in the introduction of some and the perfection of other branches of manufacture. The complaints, therefore, of the indolence of the British; of their buying fish from the Dutch rather than chusing to undergo the risk and fatigue of catching them, even on their own shores, will not, perhaps, on due consideration, appear to be well-founded. Their conduct may be ascribed rather to the very natural result of being able to employ their capital in a more lucrative, a more pleasing, and less precarious way. It would be too much to expect that he, who can buy a fish for half the money required to catch one, will quit his present employment and turn fisherman; or that he, who can make a greater and more certain profit in commerce, agriculture, or manufactures, than by fishing, will divert his capital from the former to embark in the latter.

Encouragement given to the Fisheries.

The government had repeatedly held out encouragement for the pursuit of the fisheries; and aided the efforts of individuals in various ways to promote the success of a branch of national industry of so much importance to the national wealth and strength. Liberal subscriptions for this purpose have, at various times, been set on foot; privileges and immunities have been granted; villages built at the public expence; and ships and boats with all the necessary articles and tackle, supplied; premiums have been conferred, bounties granted, duties exempted, the fishermen have been protected from the impress, and those who may have followed the occupation for seven years allowed to set up, and freely exercise, any trade or profession, in any town or place of Great Britain.

The failure, therefore, could not always have been owing to want of protection and encouragement; though it may, in some measure, to the want of knowledge or circumspection in the way of administring it. Neither could it be ascribed to the want of funds. In 1580, a plan was matured for raising L.80,000 for establishing the British fishery. In 1615, the same sum was raised by a joint stock company. In 1632, a royal fishing company was established, by the sanction of King Charles I. who, in order to increase the demand, prohibited the importation of foreign fish, directed a supply to be furnished for his fleet, and ordered Lent to be more strictly observed. In 1660, Parliament granted a remission of the salt duties, and freed all the materials employed in the fisheries from customs and excise. In 1661, the national fishery met with great encouragement under the auspices of Charles II. In 1677, this monarch incorporated the Duke of York and others into "The Company of the Royal Fishery of England;" but, on this occasion, the miserable capital was exhausted in the purchase and fitting out of a few busses, built in Holland, and manned with Dutchmen, which were seized by the French on the breaking out of the war. In 1713, it was proposed to raise L.180,000 on annuities, for the purpose of establishing a fishing company. In 1749, by the recommendation of George II., in his opening speech to Parliament, and, in consequence of a Report of a Committee of the House of Commons, the sum of L.500,000 was subscribed for carrying on the fisheries, under a corporation, by the name of "The Society of the Free British Fishery," of which the Prince of Wales was chosen the governor. This society, patronised by men of the first rank in the kingdom, promised fair for a little time, but soon began to languish; nor was the large bounty of 56s. a ton able to prevent its total failure. The attention of Parliament was again called to this great national object in 1786, when a new corporation was formed, under the name of "The British Society for Extending the Fisheries and Improving the Sea Coasts of the Kingdom," which has continued, with various modifications, to the present time; and, as we shall presently see, has been of late years in a flourishing and progressive state of improvement.

Present impediments to the progress of the Fisheries, exaggerated.

Thus, then, it is evident, that we must look for the real grounds of the general languishing state of the British fisheries, in other causes than those which have usually been assigned by our ancestors; and though the complaint, in modern times, may have some foundation, which is almost exclusively levelled against the salt duties, and, after these were wholly removed, against the numerous checks and excise regulations, which are stated to be as grievous and discouraging as were the duties themselves; yet the impediments which these are alleged to

throw in the way of the improving state of the fisheries, have probably been much exaggerated. There can be no doubt that much benefit would be derived from a total repeal of all the acts relating to the duties and the regulations of salt; and yet, when the old writers stated their grievances, the article of salt is never once mentioned. In fact, there were then neither duties nor restrictions on this article of universal use; and yet the fisheries did not flourish under the free and unlimited use of it.

The salt-duties originated as a *war tax*, in the ninth year of William III.; and in the first year of Anne, a regular salt code was established, and confirmed by five several statutes in the same reign. George I. and II. added but little to the salt-laws; but the present reign, as Sir Thomas Bernard observes, has "greatly *enriched* the code by voluminous and contradictory clauses, sometimes in the form of guards to the revenue, sometimes in the semblance of bounties, drawbacks, and allowances, surrounded by pains and penalties, oaths and perjuries, and so extended and involved, as to be quite beyond the comprehension of those who are peculiarly affected by them:" he adds, that "since his Majesty's accession, no less than thirty acts have been passed on the subject of these duties, and not less than 300 pages of additions made to our *saline-code*." Sir Thomas, as an active member of "The Association for the Relief of the Manufacturing Poor," took great pains to ascertain the bearing which the duties and regulations on salt had on agriculture, manufactures, and the fisheries. His conclusion, with regard to the latter, is, that the act of 57th Geo. III. which permits an unlimited allowance of rock-salt, duty free, though it may not come within the reach of the poor solitary fisherman, will benefit those whose capitals are engaged on a larger scale. This act also, by increasing the allowance of duty-free salt on *dry-salted* cod, ling, and hake to 70 lbs. *per* cwt. of fish, which, by a former act (55th Geo. III.) was limited to 50 lbs., is stated to have had a salutary effect on those fisheries. As a proof of this, it is mentioned, that, on its being understood, at the time of passing this latter act, that the duty-free allowance was to be fixed at 70 lbs., the persons concerned in the *North Seas and Iceland fisheries*, who were preparing to take advantage of it, immediately abandoned the enterprise on finding the blank filled up with 50 lbs. of salt *per* cwt. of fish.

The restrictive regulations for securing the duties on salt, and for the prevention of fraud on the revenue, were necessarily minute and severe in a case where those duties were equal to forty times the value of the original article, and the temptation consequently great in proportion. But their operation, by the last act, is little or not at all felt by the established fisheries, though it still continues to affect the individual or occasional fisherman, who cannot afford to keep a stock on hand, for which he is accountable, which is liable to waste, and which for many months he may not have occasion to use. Every one must be convinced that the total repeal of the salt laws would be a great boon to the whole community; but equally convinced that, in the present state of the country, the revenue could ill afford to be diminished to the extent of L. 1,500,000. If Parliament would consent to a commutation of 5 *per cent.* on all houses of and above the annual rent of L. 20, it would probably make good this sum, and would deserve the thanks of the whole community.

The salt laws, however, operate only as a very partial discouragement to the prosecution of the fisheries; and not at all, as already observed, where they are established and conducted on a grand scale. What then, it may be asked, is the real cause of our fisheries not being carried on to a greater extent, at a time when provisions are dear, and work not to be found for multitudes of the labouring classes of the community? It certainly is not that the government is indifferent of, or insensible to, the political importance of the fisheries. It has not only at different times held out such encouragements as were deemed conducive to the end in view, but shown itself so jealous of the interference of our neighbours, as to attempt to establish an appropriate and exclusive fishery in all the seas surrounding our coasts. Thus James I., in 1600, issued a proclamation inhibiting all persons of what nation or quality soever, not being natural born subjects, from fishing upon any of the coasts and seas of Great Britain and Ireland, and the isles adjacent, without first obtaining licences from the King, &c. But this, as well as the repetition of it by Charles I., in 1636, was utterly disregarded by the Continental powers. To enforce this measure, the Duke of Northumberland, as Admiral of the Fleet, was sent into the North Sea to compel the Dutch fishermen to take licences, and pay for the same, but the Ambassador of the States-General in England remonstrated against this unprecedented proceeding, and disavowed the acts of their fishermen.

The attempt to set up a limited fishery, and to prescribe boundaries to the prohibited grounds, met with no better success; but they showed, at least, a desire to prevent the advantages derivable from this element, from falling into the hands of others. It is probable, however, that these claims were set up with the view rather of maintaining the title of the sovereignty of the seas, than from any contemplation of the national advantages derivable from the encouragement of the fisheries; and more especially for the purpose of preventing any encroachments on the part of the Dutch and French.

Real Cause of the Backward State of the Fisheries.

The simple fact we take to be this; that the success of the fisheries, like that of every other speculation, must depend mainly on the two great hinges on which all commercial enterprises turn—supply and demand; where these exist to any great extent, and without any material fluctuation, the success of a fishery establishment cannot be doubtful. If, however, the supply be not equal to the demand, the article will be in danger of falling into the hands of monopolists, whose common practice is to add to the scarcity, in order to enhance the price. By thus contracting the supply within its natural limits, they not only raise the price, but reduce the demand. On the contrary, where the supply exceeds the demand, the market becomes glutted, the prices are too low to afford a suitable return for the expendi-

ture, and the adventurers withdraw their capitals, and turn them into some other channel. But a certain and steady demand creates competition, and regulates the supply to the wants of the consumer at a fair and reasonable price.

Want of Steady Demand.

It is the want, we conceive, of this steady and constant demand, and not of supply, which has at all times operated to the discouragement of the British fisheries. That the supply of fish is most abundant, and indeed inexhaustible, on the coasts of Great Britain, has never been called in question. "The coasts of Great Britain," says Sir John Boroughs, "doe yield such a continued sea-harvest of gain and benefit to all those that with diligence doe labour in the same, that no time or season in the yeare passeth away without some apparent meanes of profitable employment, especially to such as apply themselves to fishing; which, from the beginning of the yeare unto the latter end, continueth upon some part or other upon our coastes, and these in such infinite shoales and multitudes of fishes are offered to the takers, as may justly move admiration, not only to strangers, but to those that daily bee employed amongst them." That this harvest, ripe for gathering at all seasons of the year—without the labour of tillage, without expence of seed or manure, without the payment of rent or taxes—is inexhaustible, the extraordinary fecundity of the most valuable species of fish would alone afford abundant proof. To enumerate the thousands, and even millions of eggs which are impregnated in the herring, the cod, the ling, and, indeed, in almost the whole of the esculent fish, would give but an inadequate idea of the prodigious multitudes in which they flock to our shores; the shoals themselves must be seen to convey to the mind any just notion of their aggregate mass. The herring, for instance, makes its appearance in shoals, whose dimensions are measured by leagues and miles, moving steadily along in close array, and in columns of such depth from the surface downwards, as to have obtained the name among the northern nations of *herring mountains*. These columns advance yearly from the northern seas, early in the spring, with undiminished numbers, though preyed upon by a multitude of enemies, as well from the shore, as in their native element and in the air. Wherever their vast columns proceed, if unmolested by man, they have to sustain constantly the attacks of the grampus, the porpus, the shark, cod-fish, and even haddocks; and if they approach the surface, they are seized by the innumerable flocks of seagulls, gannets, and other aquatic fowls, which hover along their line of march. Where the spawn of the herring is usually deposited, naturalists seem not to be agreed; but as young herring have not been caught either with the old ones, or within the limits of the fishery, and as the shoals invariably proceed from the northward, making their first appearance about the Shetland Islands in the month of April, it has generally been thought that their winter habitation is within the arctic circle, under those vast fields of ice which cover the northern ocean, where it fattens on the swarms of shrimps, and other marine insects, which abound in those seas, and which afford also the principal food of the whale. Here it is supposed they deposite their spawn, and, on the return of the sun toward the northern hemisphere, again rush forth in those multitudinous hosts, which exceed the power of the imagination to conceive.

The pilchard, which is a species of the same genus as the herring, is also a migratory fish, but makes its appearance from the southward, in vast shoals, inferior only to those of the former; which is also the case with the mackerel, both being of equal or greater fecundity with the herring, and liable to the attacks of the same enemy. The salmon is equally regular in its visits to the coasts of Great Britain and Ireland, and approaches the mouths of our rivers in shoals, which they ascend to considerable distances, surmounting every obstacle, in order to find a safe and convenient spot to deposite their innumerable eggs. The various kinds of white fish, as turbot, sole, plaice, whitings, and haddocks, are plentifully dispersed over various parts of the British seas, affording an inexhaustible supply of fresh fish for home consumption throughout the whole year, without the least apprehension of such supply being exhausted or diminished. On the eastern shores of Great Britain, and on the rocky coasts of the Orkney and Shetland Islands, are plenty of lobsters, which would more than supply the market of the metropolis with this article of luxury, as the south-eastern and southern coasts do the oyster with its nutritious food for eight months in the year.

Use of Fish scarcely known in the interior.

In spite, however, of this abundant supply of wholesome, palatable, and nutritious food, yielded by the surrounding seas of Great Britain, every acre of which is infinitely more productive than the same quantity of the richest land; notwithstanding that these salt-water fields are perpetually "white to harvest," it is a remarkable fact, that in the inland and middle counties of England, the labouring classes scarcely know the taste of fish, which, of late years, has become a scarce article, even in most of the maritime counties. Formerly salmon was the common food of all ranks, while in season, in the northern counties bounding on the sea, and in most parts of Wales; and what could not be used fresh, was sälted for winter consumption; scarcely a family in the neighbourhood of a sea-port or salmon fishery that did not lay up a supply of pickled salmon for the winter. In the progress of luxury, well-boats were invented to convey the fish fresh to the London market, yet these were not sufficiently numerous to carry off the whole supply. The next contrivance was that of packing them up in ice, by which they could be kept fresh for a length of time, and conveyed either by land or water to the metropolis; since which the local markets have nearly been left without a supply, even for the few families who can afford to pay an extravagant price for it. That price in London is greatly enhanced, by the trade being almost exclusively in the hands of monopolists, who have it at all times in their power to create an uncertainty in the supply, and consequently a fluctuation in the price, both of which are detrimental to an augmented demand.

London monopoly and its Effects.

That a narrow confined corner, at the very extre-

mity of the metropolis, should continue to be allowed the privilege of absorbing all the fish that shall be brought within the radius of seven miles round its vortex, is an extraordinary fact, and but ill accords with the boasted good sense of these enlightened times. It needs scarcely be mentioned, that Billingsgate is this favoured spot; holding by charter an injurious and hateful privilege, which, as Sir Thomas Bernard justly observes, " in the greatest and most populous city in the world, restricts the sale of an essential article of life to a small and inconvenient market; and has exclusively placed the monopoly of fish in the hands of a few interested salesmen." The consequence of which is, that a sort of *blockade* checks the supply of fish for the metropolis; that large quantities are withheld or destroyed as they approach the market in order to keep up the price; and 2,000,000 of people nearly prohibited from the use of an article of food, which might be applied to the diminishing of the consumption of butchers' meat and wheat-corn, to the great relief of the whole kingdom. The tricks and abuses practised by the fishermen, the salesmen, and the fishmongers, who act in concert, are well calculated to create a scarcity, even if perchance more fish should arrive than are sufficient to feed the market; their object being to prevent the prices from descending one particle below the point of the smallest profits in their sale. In order to effect this, they have generally a depot of well-boats and store-boats ready stocked about Gravesend; and with these, and the assistance of a good stock of ice, they are enabled to dole out their fish for the daily use of those who have the means to purchase, and who form but a small proportion of the inhabitants of the metropolis. In the height of the season of any particular species of fish, when the catch is abundant, such of them as get sickly are thrown over-board; but towards the end of it, when, from increasing numbers, a large stock remains on hand, and other kinds come into season, thousands of sickly and emaciated lobsters, crabs, cod-fish, &c. are thrown into the market, hawked about by basket women, and sold somewhat cheaper when they are no longer fit to be eaten.

The " Committee of the Fish Association" have stated some curious particulars with regard to the practices of the fish monopolists, and the injurious effects of confining the fish-market to one little spot in the metropolis. They reckon up four principal impediments to an increased supply and distribution, of which they strongly recommend the removal by all practicable means. The first, which, in fact, produces the rest, is the restriction of the market to Billingsgate; the second is the doubt and hesitation of fishermen in bringing up to this only market so large a quantity of fish as they might procure, under an uncertain demand for it; the third, the difficulty and the increased expence of distribution from their above-mentiond remote market; and the fourth, the uncertainty of the price, and the total ignorance in which the public are kept as to the *daily state* of the supply.

The evils of the Billingsgate monopoly are strongly exemplified in the case of mackerel, which is known to be scarcest in the market, when most abundant in the British channel: then, indeed, the mackerel fishery is abandoned by the fishermen for two reasons; the one is, that they would be too cheap; the other, the difficulty of distribution, which is effected by fisherwomen, who attend daily at Billingsgate to purchase the mackerel, and carry them for sale to the different parts of the town; the attendance of these women secures to the fishermen a regular custom for their fish; but this laborious, and not always profitable employment, is abandoned as soon as the common fruit comes into season, the carriers and distributors finding the sale of strawberries, gooseberries, currants, &c.—a more pleasant and profitable occupation, with less risk and trouble. All the mackerel which may arrive at this period beyond the estimated demand of the fishmongers, however fresh and good, is thrown into the Thames. Perhaps, therefore, in the case of this particular fish, a free and unrestricted use of salt might be the means of procuring and preserving a considerable stock of palatable and nutritious food.

It is the more surprising that these impediments to a more extended use of fish in the metropolis, so obviously arising out of the chartered privilege of Billingsgate, should so long have been suffered to exist, especially as nothing more is required for the dissolution of this injurious monopoly, than the establishment of new markets. The evils of this monopoly are not of recent date. In early times, there appears to have been a regularly established fish-market at Queenhithe. In the first year of Henry III. (1226), the Constable of the Tower was ordered to compel the boats, arriving with fish, to proceed to that market; and Edward IV. directed that two out of three vessels, arriving with fish, should proceed to Queenhithe, and the other remain at Billingsgate. At that period, the population of London and its environs appears to have been about a twenty-fourth part of its present amount, yet it had then two fish-markets. The market of Queenhithe, however, was suffered to drop; and we hear of no attempt to establish a second, until the middle of last century, when an act was passed, in the year 1749, " for making a free market for the sale of fish in the city of Westminster; and for preventing the forestalling and monopolizing of fish." Yet, strange and unaccountable as it may appear, this act was then, and has since remained, a dead letter. Westminster, since that time, has increased its population at least three-fold, and is still without a fish-market. The act has never been repealed, and requires only the nomination of new and more efficient commissioners to carry it into effect. If, in the vicinity of all the bridges across the Thames, fish-markets were once established, the fishermen of Deal, Dover, Hastings, Brighton, and other parts of the coasts of Kent and Sussex, would amply supply those markets by land-carriage, with the ordinary kinds of fish in addition to the more valuable kinds brought up the Thames; and it could not fail to increase the general use of fish in and about London, if, when the Regent's Canal shall be opened, two or three fish-markets were established near it for the supply of Islington, Pan-

cras, Paddington, and the whole line of London along the new road, containing an immense population almost entirely cut off from the use of fish. The only arguments in favour of keeping back the fish, and throwing them overboard, is the frequent westerly wind which prevents the fishing-vessels from proceeding to the market up the Thames; but that excuse is now done away by the numerous steam-vessels which could easily tow up the fishing-boats.

Demand should be created to take off the supply.

The supply, as we have stated, is inexhaustible; and the means are within our reach of availing ourselves to any extent of that supply; but the demand appears obviously to be neither so steady and certain, nor so extensive, as it might and ought to be; and hence the real cause of the failure of all the plans for extending the fisheries. When the catch was abundant, the fishermen had no home market to take the fish off their hands; and a bad season impoverished the funds of those who had embarked on a larger scale for the foreign market. The promoters, dissatisfied, withheld their contributions; and the fishermen, dispirited, and without capital, directed their industry into another channel; and too frequently, from their knowledge gained of the opposite coast, and new connections formed there, into a channel destructive to their morals and injurious to the revenue.

Observations on the Bounties.

The encouragement given by the government in the shape of bounties, was not sufficient to counteract the evils that have been stated, and appears to have contributed but little to the success of the fisheries. If a branch of trade once fairly established will not support itself without being bolstered up by bounties, it never can be worth carrying on. Bounties should only be continued for a definite time, and decreased gradually. Those on the fisheries should be given on the quantity procured, and the quality of those cured, and not on the instrument of their production—on the fish, and not on the vessel. It was proved by a Committee of the House of Commons, in 1785, that the herring-fishery absolutely cost little short of L.20,000 annually, which, on an average of ten years, was equal to L.75 *per cent.* on the value of all the fish that had been taken by the vessels on which it was paid. Adam Smith has justly observed that a tonnage-bounty, proportioned to the burden of the ship, and not to her diligence and success in the fishery, is not the best stimulus to exertion; it was an encouragement for fitting out ships to catch, not the fish, but the bounty; or to induce rash adventurers to engage in concerns which they do not understand, and cause them to lose, by their ignorance, more than is gained by the liberality of government. The carelessness of such persons, and the ignorance of those employed by them in curing and packing the fish, not only robbed the public purse, but destroyed the character of the article in the foreign market; where, if saleable at all, it fetched only an inferior price, while the skill and attention of the Dutch secured for their fish that preference to which they were justly entitled. The change of the bounty, however, from the tonnage to the quantity and the quality of the fish caught and cured, with the regulations adopted by the acts of 48th and 55th Geo. III. have had the good effect of raising the character, and consequently increasing the demand for British fish in the foreign markets, where the herrings in particular are now held in equal esteem with those of the Dutch. This bounty, granted by the act 48th Geo. III. c. 110, is 2s. *per* barrel on all herrings branded by the proper officers, and 4s. a barrel granted by the act 55th Geo. III. c. 94, and is so considerable, that, at this time, it amounts to a sum not less than L.30,000 a-year.

Nothing can more strongly exemplify the good effects arising from the measure of shifting the bounty from the tonnage to the actual quantity of fish taken, gutted, and packed, than the following official return, for the year ending 5th April 1818:

AN ACCOUNT of the Total Number of Vessels, including their repeated Voyages, which have been cleared Outwards for the British Herring-Fishery, *not on the Tonnage Bounty*, in the year ended 5th April 1818; distinguishing the number of Men on Board, the Tonnage, Netting, Salt, and Barrels carried out.

Vessels.	Men.	Tonnage.	Netting.	Salt.	Barrels.
Number.	Numb.	Tons.	Sq. Yards.	Bushels.	Number.
884	4,049	$26,951\frac{16}{94}$	2,490,660	224,133	125,185

THE RETURN, for the same year, of the Total Number of Vessels which were fitted out in Scotland, for the "Open Sea-Fishery," under the Regulations of the 48th and 55th Geo. III., is as under:

Vessels.	Tonnage.	Men.	Netting.	Herrings	Premiums Paid		
Numb.	Tons.	Numb.	Sq. Yards.	Barrels.	*L.*	*s.*	*d.*
19	$464\frac{68}{94}$	139	$191,638\frac{1}{2}$	$946\frac{1}{2}$	1308	0	0

Experiments showing the possibility of extending the Demand.

It would appear, therefore, that all which is now wanting for the encouragement and extension of the British fisheries is a constant, steady, and increased demand, in the home and foreign markets. An experiment made by Mr Hale, one of the members of the committee for the relief of the manufacturing poor, proves decisively how easy it would be to introduce the general use of fish in the metropolis. He agreed with some fishermen to take from ten to twenty thousand mackerel a day, at a price not exceeding 10s. the hundred of six score, or at a penny a-piece, a price at which the fishermen said they could afford to supply the London market to any extent, provided they were sure of a regular sale. On the 15th June 1812, upwards of 17,000 mackerel were sent to Spitalfields, and sold at the original cost of a penny a-piece, to which place women were employed to carry them from Billingsgate until eleven o'clock at night. They were purchased with avidity, and vast numbers continued to pour into Billings-

gate. They were sent to other parts of the town, and sold to the poor at the same rate; and it is stated that "the supply increased to so great a degree, that 500,000 mackerel arrived and were sold in one day." The whole cost of this experiment for the distribution of fresh and sweet mackerel at a penny a-piece, was L.55, 10s. expended chiefly in the carriage from Billingsgate. In like manner, it is estimated that herrings might be supplied in any quantity at one halfpenny a piece, and cod, haddocks, whitings, flounders, &c. proportionally cheap, provided a steady demand was created, as it is presumed there would be, by the establishment of several regular markets in different parts of the metropolis.

Another experiment of the committee shows how easily a demand for salted or corned fish might be created in the inland counties. They contracted for 200 tons of corned cod, caught and cured on our own coast, and also for 400,000 corned herrings. The former was supplied to the distressed manufacturers of Sheffield at twopence halfpenny a pound, and the latter at the rate of two for three halfpence. Here, as well as in other parts of the country, the poor, it is stated, received the fish distributed among them at low prices with the liveliest gratitude; and one gentleman in Worcestershire states that "The herrings, in particular, have proved a bonus to the poor of the most essential benefit. We sold them," he says, "at a very low and reasonable rate, on account of the extreme indigence of the purchasers; and they have produced L.40 (profit), which, after the expence of carriage is paid, will be laid out in employing the poor in repairing the roads."

It deserves to be mentioned, as an instance of the certainty of a supply to answer the demand, that, when the "Association" was formed in 1812, the North Sea and Iceland fishery had for some time entirely ceased; but, on the Committee offering the fishermen L.18 a ton for all the fish they should catch and cure, they supplied, in the first instance, 100 tons of dry-salted, and 50 tons of fresh cod. In the second, 200 tons of dry-salted, and 100 tons of fresh. In the third, 600 tons of dry-salted, and 300 tons of fresh; in all 1350 tons of fish were taken and brought to market in consequence of this offer, not a fish of which would otherwise have been caught.

The obvious policy, then, to be pursued for extending the British fisheries, is by creating an extended and constant demand. In the foreign markets this can only be done by the care and attention bestowed in curing the fish, so that, in point of quality, it may compete with those of the Dutch and other nations of the Continent; a point which we have just now happily attained; but in the supply for home consumption, every thing almost yet remains to be done. The *Fish Association* have, however, clearly shown the way of proceeding to obtain this desirable end; they have proved that, not only in the metropolis, but in the interior of the country, the poor have none of those prejudices, which were ascribed to them, against the use of fish, when it is fresh and sweet, and when they are able to procure it at a moderate price. A free circulation, by means of markets established in the metropolis and at all the fishing ports, might effect this to a certain degree; but, in addition to these, some artificial expedients might be advisable, for a time at least, to raise and keep steady the demand. It is much to be regretted that Queen Elizabeth, who was well aware of the importance of the fisheries, in a political as well as economical point of view, did not, in regulating the church ritual, ordain two days in every week to be set apart by Protestants as fish days, which would have created a steady and permanent demand for fresh and salted fish in every part of the United Kingdom. Such an ordinance might, in her reign, have been enforced, and long habit would have reconciled people to the observance of those days in our times; but it would be in vain to attempt the introduction of any such custom in the present refractory generation. There seems, however, to be no good grounds of objection to those who are maintained at the public expence being fed, twice a-week, with a wholesome meal of fish. It is neither just nor politic that, while the poor labouring man, after toiling the whole week, can scarcely procure a little brown bread and a few potatoes for his wife and children, the indolent pauper should feed on the best white bread and choice butchers' meat. Supposing the number of paupers receiving parish relief, of convicts in the hulks, criminals in the jails, and, in short, all those who are fed at the public expence, to amount only to 1,000,000; and that to each was served out, twice a-week, a sufficient allowance of good fresh fish, corned cod, or salted herrings, according to the season of the year and the situation of the parties, which could be amply provided for the value of threepence a-head, the annual demand of fish, from this source alone, would amount to the sum of L. 1,300,000. The voluntary consumption of the labouring poor would be at least equal, could an adequate supply be obtained at a cheap rate; and that it might will readily be inferred, when it is stated that, in the herring season, these fish may, on an average, be purchased at the stations for sixpence a hundred, and the salt required to cure them costs about one penny. Supposing the whole expence of a hundred to be one shilling, and one shilling more for land carriage to the farthest point in the interior; and allowing the retailer a profit of 100 *per cent.*, a good salted herring might still be purchased for one halfpenny, and two herrings, with a few potatoes, would furnish a wholesome palatable meal. Salted or corned cod would be supplied almost equally cheap; and thus the quantity of food for the subsistence of man would be greatly increased, the fisheries encouraged, the consumption of butchers' meat lessened, and more pasturage converted into corn-lands, by which the enormous sums of money which are annually sent out of the country for the purchase of foreign corn would be employed at home. At present we have to trust for a supply of this "staff of life" to a miraculous plenty or a ruinous importation.

Political importance of the Fisheries.

It would be superfluous to dwell on the political, economical, and commercial importance of encouraging and improving the fisheries, to an insular empire

Fisheries.

like ours. We shall only observe, that, by their augmenting the quantity of food, there would necessarily result a reduction in the prices of all the necessaries of life; the condition of the labouring poor, the artificers, and trades-people, would as necessarily be improved; they would not only be the means of rearing and supporting a bold and hardy race of men for the defence of the sea-coast, but also of creating a nursery of excellent seamen for the navy in time of war, and of giving them employment when peace may render their further services unnecessary. If the fisheries flourished to that extent of which they appear to be capable, every seaport town and little village on the coasts, or on the banks of the creeks and inlets, would become a nursery of seamen. It was thus in Holland, where the national and natural advantages were very inferior to those of Great Britain; for it is well observed, in the *Report of the Downs Society*, that Holland produces neither timber, iron, nor salt, all of which are essential to fisheries, and all the natural produce of Great Britain; that Holland has no herrings on her own coast, while the coasts of our island abound with them and other fish, at different and all seasons of the year; so that there are few, if any, months in which shoals of this fish in particular are not found on some part of our shores; and that her population is under 3,000,000, while ours amounts to about 18,000,000, giving to our fishermen six times the consumption of a home market that the Dutch have.

Though the occupation of a fisherman is dangerous, laborious, and precarious, yet it does not appear that the want of sufficient hands has at any time retarded the progress of the fisheries. At this moment 30,000 seamen, receiving pensions from L. 7 to L. 20 and upwards, according to their wounds, infirmities, and length of service, are located for the most part along the sea-coasts of the united empire, all of whom, not otherwise employed in the coal and coasting trade, would readily add to their little pittance they receive from a grateful public, by being employed on an element so congenial with their habits.

Actual progress of the British Herring Fishery.

With all the impediments to an extended use of fish in the home market, and notwithstanding the established character which the Dutch fish have always borne among foreign nations, it is consoling to find that the British fisheries are generally in a progressive state of improvement, and more particularly that most important of all their branches, the herring fishery. Since the act of 48th Geo. III., appointing commissioners, separate and distinct from the Customs and Excise, to superintend the distribution of bounties, stationing of officers versed in the trade of the herring fishery, persons who had experimentally and practically followed that fishery as a trade, but who are excluded from all interest or participation in the trade, the herring fishery has become with us, as it was with the Dutch, an object of national concern; the good effects of which are most sensibly felt in every part of the coast, where it has regularly been established, by the labour it provides, the demand it creates for a variety of articles required by it, and by the money it throws into circulation. By this act, an annual report by the commissioners, of their proceedings, ending the 5th April, is required to be presented to Parliament each session; containing the details of the fishery of the preceding year, together with such observations and suggestions as may have occurred, or been communicated to the commissioners, in the interval between the reports. In the report of the year ending 1814, they had stated, "that the superior value of herrings, branded by the officers of the fishery in point of quality, weight, and measure, was becoming every year to be more generally acknowledged, even in markets where, till of late, gutted herrings were not much prized; and this they ascribe to their refusal of every application for allowing bounty on barrels out of the full size of 32 gallons, and to their having directed prosecutions against the proprietors of such herrings, as had been seized for being presented for bounty in undersized barrels; and that, with other precautions respecting the proper cure of the herrings, the desired effect had been produced, of raising the character of British herrings in the foreign market." In their report of 1816, they state that they have had their attention turned to different matters calculated to improve the cure of herrings, and to raise the character of the British fishery in foreign parts; that a communication, made to them by a mercantile house of respectability, on the subject of increasing the exportation of herrings to the Continent of Europe, had been printed, and distributed among the curers throughout the kingdom; that regulations had been adopted for improving the construction of barrels intended for bounty; that the boats of the fishermen had been properly fitted up for the reception of herrings; that bounty had been refused on all barrels not full of pickle; and that the strictest orders had been given to the officers of the fishery, to apply the official brand in no case, unless both herrings and casks were in every respect such as would do credit to the establishment. In the year 1817, the commissioners point out in their report the great increase that had taken place in the exportation of British herrings to the Continent of Europe, in consequence of the communication made to and the regulations adopted by them, as contained in the preceding report; and, in the year 1818, they observe that they had received a memorial on the subject from Hamburgh, signed by a number of herring merchants of that port, bearing testimony to the improvement that had taken place in the quality of British herrings, and pointing out the means of raising their character still higher. This memorial the commissioners likewise caused to be printed, and distributed among the curers, which they accompanied with such additional observations as they conceived to be necessary, and which they state to have produced the most salutary effects. They conclude their statement with the gratifying intelligence, that the character of the British fishery is rising both at home and abroad; for that, while the quantity of herrings cured *gutted* is annually increasing, the quantity cured *ungutted* is every year diminishing;

that great as the amount of the fishery had been in the course of that year, the demand had fully kept pace with it; and that, at the end of the season, few herrings remained unsold in the hands of the curers. They further report, that while the exportation to the Continent of Europe had nearly equalled that of the preceding year, and the exportation to the West Indies and Ireland had increased, a new market had opened in the East Indies, to which different shipments of herrings had been made, by way of experiment, both from Greenock and London: that, from the former of these places, upwards of 1300 firkins were exported to Calcutta, all of which they understood were purchased by Europeans there at 20s. to 25s. *per* firkin; and that it was the intention of the exporter, in consequence of this encouragement, to ship a larger quantity next season; so that the commissioners trust, that India will soon become a permanent and valuable market for the consumption of British herrings. The report thus concludes, "It is impossible to state, within the compass of this report, the advantages resulting to the community from the prosperity of the herring fishery; but the commissioners think it their duty briefly to mention that the effects thereof are felt in almost every part of the kingdom. The fishermen have, in many cases, been enabled, by the produce of their industry, to replace the small boats formerly used, by new boats of much larger dimensions, and to provide themselves with fishing materials of superior value. The number of boats and of fishermen has been greatly increased; while, by the general introduction of the practice of *gutting*, a valuable source of employment has been opened to thousands of poor people, who now annually resort to the coast during the continuance of the fishing season, and there earn a decent livelihood in the operations of gutting and packing. New dwelling-houses and buildings, on a superior construction, for the curing and storing of the herrings, are erecting at almost every station along the coast; while the demand for home wood for the manufacture of barrels, affords a source of profit and employment to numbers of people in the most inland parts of the country."

The progress of the herring-fishery will best be seen by a summary view of the quantities *caught*, *cured* for bounty, and *exported*, in the last three or four years.

By the report of 1815, it appears that the quantity cured *gutted* was 105,372¼ barrels. By that of 1816, it amounted to 135,981 barrels, being an increase in one year's fishery of 30,608¾ barrels.

The quantity cured *ungutted*, in the former period was 54,767 barrels; in the latter 26,670¾ barrels, being a decrease of 28,096¼ barrels.

The total quantity brought under the view of the officers in 1815 was 160,139¼ barrels. In 1816, it was 162,651¾ barrels; being an increase, on the whole, of 2,512½ barrels.

The quantity branded for bounty in 1815 was 83,376 barrels. In 1816, it was 116,436, being an increase of 33,060 barrels.

The exports, on the whole, in 1815, exceeded those of 1816; but the *gutted* herrings exported in the latter year exceeded those of the former by 12,606½ barrels.

In the year 1817, the total quantity caught was 192,343½ barrels, being an increase of 29,691¼ barrels. In the same year, the quantity branded for bounty was 140,018½ barrels, being an increase of 23,582½ barrels. The quantity exported in 1817 was 138,628½ barrels, being an increase of 30,940½ barrels.

In the year 1818, the total quantity caught was 227,691 barrels, whereof 204,270¼ were cured *gutted*, and 23,420¾ *ungutted*; being an increase in the total quantity of 35,347½ barrels, and of 48,494¼ in the quantity gutted; while there was a decrease in the quantity cured *ungutted* of 13,146¾ barrels.

In this year, the quantity found entitled to bounty was 183,089½; being an increase of 43,071 barrels. In the same year, the total quantity exported was 162,339½ barrels, whereof 148,147½ were *gutted*, and 14,192 *ungutted*; being an increase in the total quantity of 23,711 barrels, and of 32,667 in the quantity *gutted*; while there was a decrease in the quantity *ungutted* of 8956 barrels.

But the report of the year ending 5th April 1819 is still more flattering than any of the former ones, as will be seen from the following ACCOUNTS, which exhibit at one view the state of the herring-fishery at the different stations in Great Britain, under the superintendence and control of the commissioners, and the officers appointed by them.

Fisheries.

Fisheries.

No. I.

AN ACCOUNT of the Total Number of Barrels of White Herrings, which have been landed from the Fishery, or Cured on Shore, in the Year ended 5th April 1819;—in so far as the same has come under the Cognizance of the Officers of the Fishery.

STATIONS.	Quantity and Description of Herrings.							Grand Total.
	Cured for Bounty.			Cured not for Bounty.				
	Gutted with a Knife, and packed within 24 hours after being taken.	Gutted *not* with a Knife, and packed within 24 hours after being taken.	Total for Bounty.	Gutted and packed *not* within 24 hours after being taken.	Ungutted.	Barrels of Bulk.	Total Barrels not for Bounty.	
	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.		Barrels.	Barrels.
Ayr, Irvine, and Saltcoats,	2,806	. .	2,806	20	462	90	572	3,378
Campbletown, . .	3,543	4	3,547	. .	1,112½	768	1,880½	5,427½
Fort-William, . .	153½	139½	293	. .	. .	117½	117½	410½
Glasgow, . .	16,525	137	16,662	63½	610	381½	1,055	17,717
Greenock, . .	24,667	303½	24,970½	31½	124	63½	219	25,189½
Inverary, . .	4,084	55	4,139	10	. .	. .	10	4,149
Loch-Broom, . .	1,383	134	1,517	1	51	185	237	1,754
———-Carron, . .	1,764½	38	1,802½	35½	325	. .	360½	2,163
———-Gilphead, .	1,456	11	1,467	. .	64	34	98	1,565
———-Shildag, .	1,667½	. . .	1,667½	72	82	. .	154	1,821½
Rothesay, . .	10,020	158	10,178	9	250	149	408	10,586
Stornoway, . .	1,230½	22	1,252½	. .	187	86	273	1,525½
Stranraer, . .	1,712½	. .	1,712½	. .	. .	52	52	1,764½
Tobermory, . .	2,832½	22	2,854½	. .	534	783	1,317	4,171½
Bristol, . . .	187	. .	187	. .	157½	. .	157½	344½
Liverpool, . .	. .	. .	. .	. .	134	1,412	1,546	1,546
St Ives, . . .	404	80½	484½	. .	151	1,071½	1,222½	1,707
Whitehaven, . .	3,481	226½	3,707½	. .	916½	64	980½	4,688
Anstruther, . .	6,966	. .	6,966	318½	1,424½	329	2,072	9,038
Banff, . . .	29,170	. .	29,170	150	50	1,027¼	1,227½	30,397¼
Burntisland, . .	3,348½	. .	3,348½	. .	308	200	508	3,856½
Cromarty, . .	13,953½	. .	13,953½	150	3,660½	. .	3,810½	17,764
Eyemouth, . .	18,181½	. .	18,181½	. .	1,099	420	1,519	19,700½
Fraserburgh, . .	19,482½	700	20,182½	65	2,850½	1,307¾	4,223¼	24,405¾
Helmsdale, . .	21,752½	. .	21.752½	465	153	506	1,124	22,876½
Leith, . . .	3,301	. .	3,301	54	909	. .	963	4,264
Lybster, . .	19,628½	. .	19,628½	88	1,015	. .	1,103	20,731½
Orkney, . .	8,714	. .	8,714	62	1,666½	66	1,794½	10,508½
Port Gordon, . .	14,299	. .	14,299	. .	167	117	284	14,583
Wick, . . .	61,111½	. .	61,111½	45	3,129	1,709	4,883	65,994½
Dover, . . .	34	. .	34	. .	46	54	100	134
London, . .	412½	. .	412½	. .	13	. .	13	425½
Portsmouth, . .	1,139½	. .	1,139½	44	3,720½	129	3,893½	5,033
Yarmouth, . .	611½	. .	611½	. .	. .	428	428	1,039½
Total, . .	300,023	2,031	302,054	1,684	25,372	11,550	38,606	340,660
Year ended 5th April 1818,	. .	. .	203,285¼	985	15,799	7,621¾	24,405¾	227,691
Difference, year ended 5th April 1819,	. .	. .	98,768¾ Increase	699 Increase	9,573 Increase	3,928¼ Increase	14,200¼ Increase	112,969 Increase

No. II.

AN ACCOUNT of the Total Number of Barrels of White Herrings which have been branded for the Bounty of 4s. and of 3s. 6d. *per* Barrel, in the year ended 5th April 1819.

STATIONS.	For the bounty of 4s. *per* Barrel.		For the bounty of 3s. 6d. *per* Barrel.		Total Herrings branded.	Amount of Bounty.		
	Bung packed.	Repacked.	Bung packed.	Repacked.				
	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	*L.*	*s.*	*d.*
Ayr, Irvine, and Saltcoats,	2,074	. .	. .	. .	2,074	414	16	0
Campbeltown, . .	2,525	. .	. .	. .	2,525	505	0	0
Fort-William, . .	95	. .	109	. .	204	38	1	6
Glasgow, . .	9,161	2,234	. .	. .	11,395	2,279	0	0
Greenock, . .	7,186½	15,870½	. .	295	23,352	4,663	0	6
Inverary, . .	3,616½	. .	50	. .	3,666½	732	1	0
Loch Broom, . .	1,205½	. .	130	. .	1,335½	263	17	0
—— Carron, . .	1,516	. .	10	. .	1,526	304	19	0
—— Gilphead, .	1,093	. .	8	. .	1,101	220	0	0
—— Shildag,	1,102	. .	. .	. .	1,102	220	8	0
Rothsay, .	7,910	632	141	. .	8,683	1,733	1	6
Stornoway, . .	1,135	. .	22	. .	1,157	230	17	0
Stranraer, . .	1,503½	. .	. .	. .	1,503½	300	14	0
Tobermory, . .	2,294	. .	. .	. .	2,294	458	16	0
Bristol, . .	. .	193	. .	. .	193	38	12	0
St. Ives, . .	244	147	. .	. .	391	78	4	0
Whitehaven, . .	1,314½	2,152	15	211	3.692½	732	17	0
Anstruther, . .	7,029	332½	. .	. .	7,361½	1,472	6	0
Banff, . .	15,949½	8,226	. .	. .	24,175½	4,835	2	0
Burntisland, . .	10,851	8,713	. .	. .	19,564	3,912	16	0
Cromarty, . .	8,987	1,690	. .	. .	10,677	2,135	8	0
Eyemouth, . .	6,073	7,422	. .	. .	13,495	2,699	0	0
Fraserburgh, . .	10,368	3,197	4	242	13,811	2,756	1	0
Helmsdale, . .	7,969	3,801	. .	. .	11,770	2,354	0	0
Leith, . . .	28,983	6,153	. .	. .	35,136	7,027	4	0
Lybster, . .	7,694½	4,866	. .	. .	12,560½	2,512	2	0
Orkney, . .	5,979½	2,182½	. .	. .	8,162	1,632	8	0
Port Gordon, . .	6,927	4,309	. .	. .	11,236	2,247	4	0
Wick, . . .	24,761½	9,772	. .	. .	34,533½	6,906	14	0
Dover, . . .	.	34	. .	. .	34	6	16	0
London, . . .	. .	359	. .	. .	359	71	16	0
Portsmouth, . .	40	517	. .	. .	557	111	8	0
Yarmouth, . .	395½	. .	. .	. .	395½	79	2	0
Total, . .	185,983	82,802½	489	748	270,022½	53,973	11	6
Year ended 5th April 1818.	131,123½	50,875	658	433	183,089½	36,590	12	6
Difference, year ended 5th April 1819.	54,859½ Increase	31,927½ Increase	169 Decrease	315 Increase	86,933 Total incr.	L. 17,382 Increase	19	0

No. III.

An ACCOUNT of the Total Number of Barrels of White Herrings which have been Exported from Great Britain, in the year ended 5th April 1819, in so far as the same have come under the cognizance of the Officers of the Fishery.

STATIONS.	Exported to Ireland.		To other places in Europe.		To places out of Europe.		Total Exported.
	Gutted.	Ungutted.	Gutted.	Ungutted.	Gutted.	Ungutted.	
	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.
Ayr, Irvine, and Saltcoats, .	165	487	. .	. .	. .	. .	652
Campbeltown, ...	1,112	1,407	. .	. .	. .	. .	2,519
Fort-William, ...	385	60	. .	. .	. .	. .	445
Glasgow, ...	5,829	614	100	. .	. .	. .	6,543
Greenock, ...	3,821½	163	. .	. .	27,642	91	31,717½
Loch-Broom, ...	165	60	. .	. .	. .	. .	225
Loch-Skildag, ...	1,105	. .	. .	. .	. .	. .	1,105
Rothesay, ...	1,186	294	. .	. .	. .	. .	1,480
Tobermory, ...	3,216	1,383	. .	. .	. .	. .	4,599
Bristol, ...	969	148	. .	. .	4,872	186	6,175
Liverpool, ...	134	. .	. .	. .	2,198	1,317	3,649
St Ives, ...	172	. .	. .	. .	. .	. .	172
Whitehaven, ...	655	325	. .	. .	2,397	177	3,554
Anstruther, ...	2,069	470	500	. .	. .	. .	3,039
Banff, ...	4,031	. .	10,822	. .	. .	. .	14,853
Burntisland, ...	2,855	252	5,463	. .	. .	. .	8,570
Cromarty, ...	2,258	665	500	. .	. .	. .	3,423
Eyemouth, ...	1,770	. .	. .	. .	. .	. .	1,770
Fraserburgh, ...	4,439	332	3,705	. .	611	54	9,141
Helmsdale, ...	2,062	. .	3,580	. .	. .	. .	5,642
Leith, ...	9,674	1,060	22,222	. .	1,638	50	34,644
Lybster, ...	465	. .	926	. .	. .	. .	1,391
Orkney, ...	3,452	1,330	. .	. .	800	200	5,782
Port Gordon, ...	2,600	. .	1,035	. .	. .	. .	3,635
Wick, ...	17,869	520	3,170	. .	. .	. .	21,559
London, ...	4,707	. .	310	. .	42,595	277	47,889
Portsmouth, ...	30	2,938½	. .	. .	20	. .	2,988½
Total, . .	77,195½	12,508½	52,333	. .	82,773	2,352	227,162
Year ended 5th April 1818, .	44,304½	9,082	43,368	528	60,475	4,582	162,339½
Difference, year ended 5th April 1819,	32,891 Increase	3,426½ Insrease	8,965 Increase	528 Decrease	22,298 Increase	2,230 Decrease	64,822½ Total Increase

Progress of the Highland Fishery.

This rapid progress shows, that there is no art or mystery in the catching and curing of herrings that the English cannot accomplish as well as the Dutch; which is further proved by the successful experiment made by the Downs Society of fishermen; in the report of whose proceedings it is stated, that herrings had been taken within the Cinque ports, of a quality so nearly resembling the deep sea fish, that they were cured and sold as the best Dutch herrings. It will be seen, also, by Table I. that the progressive increase of the herring fishery is confined to Scotland; and that the quantity brought under the inspection of the officers in England amounts not to one twenty-second part of the whole; while the flourishing little town of Wick alone furnishes nearly one-fifth. But the most extraordinary increase is that which has taken place in the neighbouring county of Sutherland. Till a few years past, the people of this county were contented to hire themselves as fishermen to the adventurers of Wick. In 1814, they attempted a fishery on their own account, and the mouth of the Helmsdale was fixed upon as the station. A storehouse and curing-house were here erected; the boats were manned by the people brought from the mountains, and the interior of the country. Every thing was new to them in the employ they were about to engage. The fishing commenced on the 20th July, and ended on the 3d September 1814; and the produce of four boats was respectively

Fisheries. L.105, 3s., L.83, 8s., L.96, 8s., and L.148, 3s. They were manned by four men each, so that they made, on an average, rather more than L.27 a man. In 1815, the number of boats employed amounted to 50, almost entirely manned by Sutherland men; and the number of barrels caught and repacked exceeded 4000, chiefly gutted. In 1817, this fishery gave employment to about 200 tenants, 17 coopers, and 130 women. In 1818, 70 coopers, 520 women, 700 men, 140 boats; and, in the present year (1819), the quantity caught and cured at Helmsdale, as appears by the Table, amounts to no less than 22,876 barrels, besides upwards of 100,000 cod and ling. While the herring-fishery is making these rapid strides in the Highlands of Scotland, the ancient town of North Yarmouth, which owes its existence to the herring-fishery, and in the time of Edward III. had an act usually called "the statute of herrings," passed in its favour, for the regulation of its herring-fair, now exhibits only the small number of 1039 barrels.

White-Fishery. But not only does North Britain take the lead in the herring-fishery, but has of late, more than before, availed herself of her favourable situation for carrying on that branch which may be reckoned next, perhaps, in importance to it, namely, the cod and ling fishery. The whole extent of sea, from the neighbourhood of the Orkney and Shetland Islands to Iceland on the one hand, and to the coast of Norway on the other, and along the eastern and western shores of Scotland, to the Flemish banks on the east and the coast of Ireland on the west, may be considered as one great fishing domain, over which the different species of the cod genus are most plentifully dispersed; as are also turbot, skate, soles, haddocks, and whitings. These fish, which constitute collectively what is usually called the *white fishery*, surround, as it were, the whole of North Britain, and give to that portion of the united kingdom advantages which its southern neighbours cannot boast of.

Turbot-Fishery. The only fishery, perhaps, which neither the Scotch nor the English follow up with equal success as the Dutch, is that of the turbot, the finest of which are supposed to be taken on the Flemish banks. The turbot-fishery begins about the end of March, when the Dutch fishermen assemble a few leagues to the south of Scheveling. As the warm weather approaches, the fish gradually advance to the northward, and, during the months of April and May, are found in great shoals on the bank called the *Broad fourteens*. Early in June they have proceeded to the banks which surround the small island of Heligoland, off the mouth of the Elbe, where the fishery continues to the middle of August, when it terminates for the year. The mode of taking turbot is as follows: At the beginning of the season, the drag-net is used, which, being drawn along the banks, brings up various kinds of flat fish, as soles, plaice, thornbacks, and turbots; but, when the warm weather has driven the fish into deeper water, and upon banks of a rougher surface, where the drag-net is no longer practicable, the fishermen have then recourse to the hook and line. Each line extends from one to nearly three miles in length, and is armed with six, seven, or eight hundred hooks, fixed to

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it at the distance of several yards from each other. To keep these long lines properly stretched, and prevent their being carried away by the tide, heavy masses of lead in some places, and small anchors in others, are attached to them. The hooks are baited with the common smelt, and a small fish resembling an eel, called the gore-bill. Though very considerable quantities of this fish are now taken in various parts of our own coasts, from the Orkneys to the Land's End, yet a preference is given, in the London market, to those caught by the Dutch, who are supposed to have drawn not less than L.80,000 a-year, for the supply of this market alone; and the Danes from L.12,000 to L.15,000 a-year, for sauce to this luxury of the table, extracted from about one million of lobsters, taken on the rocky shores of Norway; though our own shores are, in many parts, plentifully supplied with this marine insect, equal in goodness to those of Norway.

Salmon-Fishery. Scotland has very decidedly the advantage over England in the salmon-fishery, which, if not of superior value, may be allowed to rank next in importance to the cod-fishery. This fish being rarely caught except in estuaries or rivers, may be considered in a great degree as private property; and it may therefore be presumed that the fishery is conducted to the greatest possible extent and advantage. From the extremity of the Highlands, and from the Orkney and Shetland islands, these fish are sent up to the London market, as before-mentioned, in ice; and when the season is at its height, and the catch more than can be taken off hand fresh, they are then salted, pickled, or dried, for winter consumption at home, and for the foreign markets. Perhaps the fishery of the Tweed is the first in point of the quantity caught, which is sometimes quite astonishing, several hundreds being taken at a single draught of the net. It is here where the kitted salmon is principally prepared for the London market, being first boiled and then pickled with vinegar.

General Survey of the British Fisheries. The annual value of the Scotch and English fisheries, and the number of persons and craft employed on them, are but vaguely stated in the statistical reports of the several maritime counties of Great Britain; and in some of them the subject, important as it certainly must be considered in our economical system, and as connected intimately with the subsistence and employment of the labouring poor, is altogether omitted. This defect is more particularly to be regretted at this moment, when inquiries are anxiously making, not only how to employ a superabundant population, but to ascertain to what extent the powers of the country are capable of supplying the means for its subsistence. Indeed, we conceive that a statistical survey of the British fisheries, as far as it could be made out, would afford a most valuable document in aid of a more complete investigation of that branch of political economy which relates to the employment and the feeding of the people. The following brief account must, therefore, be considered as very imperfect. It is to be understood that the returns of the herring-fishery, as given in the preceding Table, are not taken into the account.

Scotch Fisheries.

Sutherland.—The waters in which the salmon-fishery is chiefly carried on in this county, are those of Naver, Helmsdale, and Brora, and the rent of these fisheries is about L. 1700 a year; the produce L. 6806. In one year (from December to March inclusive) were caught between Bighouse Bay, on the north coast, to Rou-stoir in Assynt, on the west coast, 30,000 lobsters, which at threepence a piece, the price paid to the fishermen, amounted to L. 375. They were carried in smacks to the London market, where, at that season of the year, their value was estimated at L. 7000. It is estimated that each of the 37 boats on the coast of Assynt might produce L. 100 a-year. Three boats at Golspie are stated to make about L. 150 a year by haddocks only, which are consumed by the country people. Of the quantity of cod and ling exported no account is given, but these valuable fish are taken in great abundance on every part of the coast. Whatever opinions may exist with regard to the policy of the measures which have recently been adopted with regard to the tenantry of this county, there can be but one in considering the Marquis of Stafford as a great promoter of the fisheries, and a benefactor to all who are concerned in them.

Caithness.—It is asserted, with every probability of truth, that there is no district in Europe better calculated for carrying on the fisheries, either in point of profit, variety, or extent, than Caithness. In the fresh waters of the county, and the seas by which it is surrounded, are enumerated 45 different kinds of esculent fish. Next to the herring, the cod-fishery, near Thurso, may be reckoned as the most important. Indeed, the whole coast of Wick and Latheron, and every part of the Pentland Frith, abounds with this valuable species of fish, as well as all the other kinds usually distinguished by the name of white fish. The herring-fishery, as will be seen in the preceding Table, holds a high place among the established fishing stations; and, in fact, the whole county feels the beneficial effects of an active prosecution of the fisheries, out of which has of late years risen a new town, near Wick, named Pulteney Town; and all the villages on the coast are in a progressive state of enlargement and improvement from the same source.

Ross and Cromarty.—In the report of the agriculture of these counties, by Sir George Mackenzie, are some excellent observations respecting the herring-fishery, the decline of which, previous to the late act, he ascribes to the circumstance of salt being delivered to the fishers free of duty; which made the fishermen rely on the greater part of their expences, and some part of their profits, being paid by the fraudulent practice of smuggling the salt for sale; and to such an extent was this practice carried, that it is broadly asserted, "there is not a farmer in the Highlands who uses any other than fishery salt for butter, cheese, and other provisions; there is no other salt used in private families."

The cod-fishery of Gairloch is the most productive of any on the coast of Scotland. The fishing is from January to April. The fish are small in size but rich; averaging about five pounds when cleaned for salting. They are mostly pickled, and also dried, and sent to Ireland, Liverpool, and London. The average annual produce is about 20,000 cod, taken by 20 boats, each having about 400 hooks, which number, it is stated, might easily be doubled. For the success of this fishery, those who follow it are greatly indebted to the bounty and judicious assistance of Sir Hector Mackenzie.

Nairn and Moray.—The principal fishery of this part of North Britain is that for salmon, chiefly in the rivers Nairn, Findhorn, and Spey, the whole of which, supposed to amount yearly to about L.25,000, is exported to the London market in smacks of 80 or 100 tons burden, packed to the number of three or five in a box with pounded ice. These smacks keep the sea in all kinds of weather, and generally reach their destination from the fifth to the ninth day. When salmon begins to be too plentiful in the market, it is then boiled and sent up in kits. The price is so high where caught, that salmon is considered as a luxury, and is exhibited only at a feast.

Aberdeen.—The salmon-fishery is the most considerable in this county, and most productive on the Dee and the Don. The usual practice, formerly, was to salt the fish, pack them in barrels of about four hundred weight each, and export them to the south of Europe. In 1798, the quantity caught on the Dee was equal to $1890\frac{1}{4}$ of these barrels, and on the Don 1667 barrels. At present they are sent up fresh to the London market; and it is stated, that the price, since 1768, has increased in a five-fold proportion, and that not more than one pound of salmon is consumed in the county for forty that are exported. The fishings on the Ugie, the Ythan, and coast near these rivers, vary from 200 to 600 barrels.

The ordinary sea-fishing for haddocks, cod, ling, skate, turbot, halibut, &c. is stated to employ a number of fishermen, who carry on their occupation chiefly in small creeks, and that it brings in yearly from L.15,000 to L.30,000, the greater part of which is consumed within the county; excepting about 500 barrels of cod, and a considerable quantity of ling exported from Peterhead; from which place also, and Aberdeen, the Greenland whale-fishery has been carried on with great success.

The whole of the fisheries connected with the county yield from L. 80,000 to L. 100,000 annually.

Kincardine.—The sea-fishing, or white-fishery, as it is usually called, is stated to have greatly fallen off in this county. In upwards of thirty miles of sea-coast, the annual value of the white-fish caught, and chiefly consumed in the county, does not exceed L.6000, giving employment to about 303 fishermen, or 200 families, or 900 souls. The number of boats is about 43, and of yawls 27.

The salmon-fishery is of more importance; that in the North Esk is farmed at upwards of L.2400 a-year. This, however, is the principal fishery, all the other waters in the county not producing a rental of more than L.300 a-year.

The Lothians.—Except a limited herring-fishery at Dunbar, and a local fishery for the scanty supply of the neighbouring towns, the only other fishery deserving of notice, as a branch of trade in East Lothian, is the oyster-fishery at Prestonpans. From

this place have been sent to fatten, in bays near the mouths of the Thames and Medway, thirty cargoes in one season, each cargo consisting of 320 barrels, and each barrel containing 1200 saleable oysters, which brought in about L.2500; the quantity consumed near the spot, and in Edinburgh, brought somewhat more, and this branch of trade gave occasional employment to about 40 boats.

In that part of the Frith of Forth which washes the coast of West Lothian, besides a herring-fishery, on a limited scale, a scanty supply of cod, haddocks, whitings, skate, flounders, crabs, lobsters, and oysters are taken for the use of the neighbouring towns.

Dumfries.—The only fishery of any importance in this county, is the salmon-fishery in the Solway Frith, and the rivers, chiefly the Annan, falling into it; the rents of which do not exceed L.1400 a year, and are supposed to be too high; the fishing having greatly decreased in consequence of the destructive engines made use of by the renters. It is stated by one gentleman, that the number of salmon taken is not equal to one in one hundred some forty years ago.

Inverness.—The salmon-fisheries in the lochs and rivers of this county are those of most importance, and let for about L.3000 a year. Those on Loch Beauly and Loch Ness are the most valuable. A singular method of taking salmon is described near Invermoriston, where the river flows in a narrow chasm between two projecting rocks: "The fisherman seats himself on a cleft of this rock, right over the cascade, with a spear in his hand, which has a line fixed to the upper end of the shaft, similar to the practice of fishing for whales with harpoons. Whenever the salmon makes a spring to gain the ascent over the cataract, the spearman strikes the fish and lets the shaft go, holding only by the line until the fish has exhausted his strength; then the spear and fish are thrown ashore by the stream, and taken out at the lower side of the pool."

Argyle.—The whole of this county is so intersected with sounds, straits, lochs, and rivers, that the fisheries might be carried on within them to almost any extent; and fishing is accordingly the occupation of a great number of its inhabitants; there being in the whole about 1500 fishing-boats employed, of which Lochfine alone employs 600; and the value of the fish caught is stated to be from L.40,000 to L.50,000 annually.

The Hebrides.—The following is the whole account of the fisheries of these numerous islands contained in the *Agricultural Survey*: "These" (the fisheries), says Mr Macdonald, "do not belong to an agricultural survey; but they are of very essential importance to the Hebrides, and therefore merit notice in this place. They bring into those isles L.200,000 a year, at an expence perhaps of L.120,000; that is, they yield a clear profit in money and sustenance of L.80,000 to the natives. They occupy, together with the kelp manufacture, 2562 boats and vessels of every description, and for some months in the year 10,500 sailors. The fencible men, or those between the age of sixteen and twenty, being one-fourth of the population, are 22,762; so that nearly one half of the effective male population is connected with the fishery. The principal fishing ports are Rothesay in Bute, Stornoway in Lewis, Tobermory in Mull, and Portnahaven in Islay; but the districts of Harris, Barray, South Uist, Skye, and various other islands, fit out a number of boats annually, or supply the Clyde busses with excellent mariners and fishermen."

English Fisheries.

Berwick.—London, it has been already observed, receives a very considerable portion of its fresh salmon from the fishery on the Tweed, that on the English side of the river alone giving employment to 70 small boats and about 300 fishermen. The value is not mentioned, but it is stated, in the *Survey of Durham*, that the rents amount to L. 15,766 annually, and that so far back as 1807, the number of boxes sent to London was 8445, of eight stone each, or 67,560 stone, which, at 16s. a stone, is L.54,000, besides what is killed for exportation, and what is sold fresh in the neighbourhood. The salmon, as they are caught, are packed in ice and sent away in the vessels well known under the name of Berwick smacks. Formerly it was all pickled and kitted, after being boiled, and sent to London under the name of Newcastle salmon; but the present mode has so raised the value of the fish, as nearly to have banished this article of food from the inhabitants in the environs of the fishery, except as an expensive luxury. Within memory, salted salmon formed a material article of economy in all the farm-houses of the vale of Tweed, insomuch that in-door servants often bargained that they should not be obliged to take more than two weekly meals of salmon. It could then be bought fresh at 2s. the stone, of nineteen pounds weight; it is now never below 12s. often 36s. and sometimes two guineas.

The coast fishery is not of very material importance. It gives employment to upwards of 100 fishermen, at eight small fishing stations, with about 20 boats. The fish-carriers, under the name of *cadgers*, purchase and distribute the white-fish, codlings, haddock, whitings, skate, holibut, and flounders, with a very few turbot, into the inland country, and often as far as Edinburgh. Cod and ling are generally contracted for, by the season, at a fixed price, by the fish-curers, who either salt and dry them, or barrel them, as the weather may serve. The fisheries on the coasts of Cumberland, Northumberland, Yorkshire, and Lancashire, are not once adverted to in the agricultural surveys of these counties.

Durham.—The salmon-fisheries in the Tyne, the Wear, and the Tees, are stated to have declined very much of late years, in consequence, it is supposed, of throwing dams across them, which prevent the fish from getting up the rivers to spawn.

Lincolnshire.—On the coast of this county the fisheries appear to be almost wholly neglected. There is a little fish, however, in the east and west fens, called a Stickleback, so numerous, that a man has made 4s. a day by selling them at a halfpenny a bushel. They also come from the sea into Boston haven, where they are purchased for manure, being more powerful than any other kind known, even that of the whale refuse. It is almost unnecessary to

state that, in this fenny county, pike, carp, perch, and tench, are most abundant.

Norfolk.—The Norfolk surveys take little notice of the fisheries. It appears that the sticklebacks are caught in immense quantities in the Lynn river, about once in seven years, and are purchased for manure at the rate of sixpence or eightpence a bushel. It is mentioned, however, in Kent's *Norfolk*, that herrings to the amount of L. 50,000 are annually exported, but that fish, for the use of the inhabitants, are neither regularly supplied, nor cheap; that the best fish are lobsters, soles, and cod; that the whitings are small, and the oysters very large.

Suffolk.—Besides the herring fishery carried on from Lowestoff, by forty or fifty boats of 40 tons each, the mackerel fishery is pursued, during the season, with great vigour. The value of this fish, caught in the course of six weeks, is stated to exceed L. 10,000, independent of the usual kinds of white-fish for the supply of the neighbourhood and the London market, the total value of the fishings being not less than L. 30,000 a year. Most of the herrings caught here are dried and sent to the ports of the Mediterranean.

Essex.—The oyster-fishery is of all others the most important to this county. The principal station of the dredging-boats is at Mersea in Blackwater, which, with the Crouch and the Coln, are the most extensive breeding rivers in Essex. The oysters are brought from the coasts of Hampshire, Dorset, and other maritime counties, even as far as Scotland, and laid in the beds or *layings* in the creeks adjoining those rivers. The number of vessels immediately employed in the dredging for oysters are about 200, from 12 to 40 or 50 tons burden each, employing from 400 to 500 men and boys. The quantity of oysters bred and taken in this county and consumed annually, mostly in London, is supposed to amount to 14,000 or 15,000 bushels. All the other fisheries connected with this part of the coast are stated to employ a capital supposed to amount from L. 60,000 to L. 80,000.

Middlesex.—This county, having no fishery of its own, but the very trifling one afforded by the Thames, is infinitely the greatest consumer of fish, and demands a larger supply than all the rest of the empire together. By a return of the cargoes of fish brought by water to the Billingsgate market, it appears that, on an average of six years ending 1785, the number of cargoes amounted to 1569, and of four years, ending with 1803, the average was 2428; the average tonnage being about 50 and the general average of fish in each about 40 tons, which will give nearly 100,000 tons of fish. Supposing the quantity brought by land carriage to be one-fifth of the other, the whole weight of fish brought to the London market, would amount to the enormous quantity of 120,000 tons a year, which, supposing the capital and its environs to contain 1,200,000 inhabitants, would allow 200 pounds of fish annually to each individual, and, of course, a very considerable quantity must be dried or salted fish for exportation, if the returns be at all correct.

Kent, Sussex, Hampshire, and Dorset.—In the *Agricultural Surveys* of these counties, little notice is taken of the fisheries; in the first they are not mentioned. In Sussex, the produce of the ponds in carp, tench, and perch only are noticed, and even these, it would seem, are monopolized by a London fish-dealer. In the rivers of Hampshire the salmon-fishery is carried on, but to no great extent. The little town of Hamble, on the shore of the Southampton water, has about twenty sail of well and other boats constantly employed in fishing, and go as far as the Scilly islands and the Land's End for lobsters. crabs, and craw-fish in the season. In the winter they dredge for oysters, and for about a month catch vast quantities of herrings round the Isle of Wight, whose waters also afford employment in the whitings, plaice, prawns, shrimps, lobsters, and crabs, with which they abound. Southampton market is generally well supplied with all kinds of fish, and Portsmouth pretty well, but not equally so with the former place. The town of Poole in Dorset is deeply engaged in the Newfoundland fishery. Along the sea coast of all these counties, the mackerel-fishery during the season, and the taking of the various kinds of white-fish, especially soles and whitings for the London market, and the supply of the neighbouring towns, occupy a very considerable portion of the inhabitants of the former place.

Devonshire.—The supply of salmon in the waters of Devon, was formerly so abundant, that here too the farmers, in hiring their servants, found it necessary to stipulate that they were not to eat salmon more than twice a week; but the case of late years is widely altered; the fishery having fallen off so as to be of little or no importance. This is stated to be owing to a wasteful and improvident destruction of the species, by taking the young fish on their return seaward towards the end of the year; no less than a thousand having been taken in one week at Brightley on the river Taw, where, and at Umberleigh, it has been usual for the young salmon fry, or gravellers, to be given to the pigs.

The sea-fishery is conducted with a considerable degree of activity in this county, Brixham alone having no less than 100 sail of vessels employed in the fisheries. They catch soles, whitings, flounders, gurnet, John Dories, and the red mullet in great abundance and of the finest quality, which are sent off to London, Bath, and Bristol, also to Plymouth and Exeter, and the neighbouring towns; and when, in the summer season, the catch is greater than can be disposed of, the fish are well cleaned, salted, and dried in the sun; thus prepared, they take the name of *buckhorn*, and are esteemed an excellent relish, much sought after in the navy, and also along the French coast.

Cornwal.—In addition to the different kinds of fish which are taken off the coast of Devon, Cornwal has the advantage of an annual visit of vast shoals of pilchards, equally abundant for the space they cover with the shoals of herrings. The four principal ports from which the pilchard fishery is carried on are Fowey, Falmouth, Penzance, and St Ives. At Polperro, which is perhaps the smallest establishment, upwards of forty boats and nearly 200 fishermen are engaged in the hook and line fishery, and the aggregate value of the fish taken, is supposed to amount

Fisheries.

to L. 5000 annually, most of which is distributed all over the country to the distance of thirty miles by men and women carriers. The markets of Exeter and Bath, Plymouth, Liskeard, Tavistock, &c. receive supplies from hence; and lobsters are delivered to the Southampton well-boats for London. The neighbouring poor are supplied almost all the year round with fresh and salted pilchards. Indeed, the multitudes which are taken of those fish are enormous on the coast of Devonshire as well as Cornwall, between the months of July and September inclusive, when the whole line of coast presents a scene of bustle and activity. The fish for foreign export and winter consumption are laid up on shore in large stacks or piles, with layers of salt between each row; here they are suffered to lie for twenty or thirty days, during which time a vast discharge of pickle mixed with blood and oil takes place, all of which is carefully caught in pits and preserved for manure, which is eagerly purchased by the farmer and carried away in casks. It is said that every pilchard will dress and richly manure one square foot of ground. The fish are then carefully washed with sea water, dried and packed in hogsheads, in which state they are sent abroad. The average value of pilchards taken in one year in Cornwall is supposed to be from L. 50,000 to L. 60,000.

Somerset.—The salmon and herring-fisheries of Porlock, Minehead, Watchet, and other places on the shores of the Bristol Channel, are stated to have been carried on to a considerable extent, since the duty on salt used for curing fish for home consumption has been removed; and the increase of the latter fishery has been the means, not only of furnishing employ during the winter for the seamen who are engaged in the lime, stone, and culm trade, during the summer, but of providing a cheap and wholesome food for the labouring class of inhabitants.

Fisheries of Wales.

The great extent of coast, washed by the sea, and the numerous fine streams and navigable rivers by which it is intersected, give to the principality of Wales the advantages of a fishery little if at all inferior to those of Scotland. In South Wales, Milford Haven, and its tributary streams, the Towy, and its branches, the Laughor, the Teivy, and the Dovy, all navigable, abound with the finest salmon, sewin, trout, samlets, &c. and the same kind of fish are equally plentiful in the twenty-two inferior streams, which fall into the sea on the coasts of the four maritime counties of Glamorgan, Caermarthen, Pembroke, and Cardigan. The value of the salmon sent to Bath and Bristol from Monmouth alone, the produce of the Wye, Usk, and Rumney, is said to exceed L.4000 annually, exclusive of what is consumed in the county. The sea affords them annual shoals of herrings, which, with potatoes, is one of the chief articles of sustenance for the poor. They first appear in the bay of Cardigan towards the middle of September, just as the harvest is finished. The other sea fish are cod, haddocks, whitings, skate, ray, turbot, plaice, flounders, soles, mullets, gurnards, mackerel, dories, shad, &c. Shell-fish of all kinds are most abundant, and in various parts of Milford Haven are inexhaustible beds of oysters, of superior excellence. Those of Tenby and other parts of the coast are of enormous size, but of inferior quality to those taken in Milford Haven.

Fisheries.

It is worthy of remark, that the *sewin* is a fish peculiar to South Wales, and is not found in any river east of the Wye, or north of the Teivy, but frequents all the intermediate rivers, which they visit annually about the beginning of June, and continue in season till the end of August, weighing from 1½ to 4 or 5 lbs. each. The samlet is a small fish about nine inches long, and frequents all the rivers in which salmon and trout are found; and it has been concluded, from the circumstance of a female samlet being utterly unknown, that they are the hybrid offspring of the female salmon and the male trout. As an article of food, they are excellent when fried, potted, or pickled.

In North Wales, the sea fish are of the same description as those of the southern coast; and the herring-fishery in the bay of Caernarvon is, perhaps, the most flourishing in all Wales; but the badness of the roads, and the distance by sea from any great market, check the demand for fish, and discourage the people from following the occupation. A good road from Caernarvon into Shropshire, to open a direct and speedy conveyance to the heart of England, where sea-fish is scarcely known to nine-tenths of the community, would be the means of increasing the demand for this palatable and wholesome food, of which the supply, along the extensive coast of North Wales, is inexhaustible.

Irish Fisheries.

The sea-coasts of Ireland are as abundant, and perhaps more so, in every valuable species of fish, as those of Great Britain. Its numerous bays, creeks, inlets, lakes, and rivers, swarm with them. It is visited annually by vast shoals of herrings, and the banks near its shores are well stored with excellent cod, hake, and ling, equal in all respects to those caught on the banks of Newfoundland. With the westerly winds, which may be reckoned to blow for nine months in the year, the produce of these fisheries might always be sent to ready markets at Bath, Bristol, Liverpool, and other great towns on the western and southern coasts of England; yet, either from indolence, want of inclination, or, which is more probable, want of capital, and most of all from want of proper regulations, the Irish have hitherto done little more than procure from their fisheries a scanty supply for the chief towns, and the families of those who are resident near the coast. It would seem, indeed, that the Irish have not much taste for a seafaring life, few of their young men volunteering for the navy, while they go in shoals into the army; and those few who follow the occupation of fishermen are so much prejudiced in favour of their own clumsy methods of proceeding, as to resist all attempts at improvement. It is stated by Mr Whately, in his *Hints for the Improvement of the Irish Fishery*, that, when the trammel net was attempted to be introduced, by which, in a couple of hours, more fish might be taken than with their hookers in a whole night, such was the prejudice against this new mode of fishing, that the crews of the hookers, alarmed at the supposed diminution of their profit by the increased supply, combined together along the whole coast, and destroyed the trammel nets

wherever they were discovered. There is, however, a species of trall not commonly made use of, which, according to the opinion of Mr Mitchell, is highly injurious to the Irish fisheries.

"The common method of fishing in this manner on the coast," says this author, "is with what they call a beam-trail, or trall, which consists of a large beam, or pole, generally between twenty and thirty feet long, headed at both ends with large flat pieces of timber, which resemble the wheels of a common cart; except that, instead of being round, like them, they are rather semicircular, or resembling a heart cut in two, lengthways. They are shod, like the wheels of a cart, with iron. To this beam the trail net or bag is fixed, and at each end ropes are fastened, by the help of which the ground is entirely swept so clean, that I have been assured a fisherman will venture to throw his knife or any other such small matter overboard, in thirty or forty fathom water, and readily take it up again; and thus the ground is swept clean for a considerable tract; at every put, as they call it, the boat commonly sailing a mile, or perhaps a league, before the bag and beam are hauled up.

"It has great inconveniencies; for, *1st*, It sweeps and tears away all the sea plants, moss, herring-grass, &c. which some fish feed on, making those species to seek elsewhere for food. *2dly*, It disturbs and affrights the larger kinds of fish, as cod, ling, &c. in the same manner as if pursued by larger fish of prey. And, *3dly*, which is worse than all, these beam nets, and others of the kind which are dragged along the ground, tear away, disturb, and blend up the spawn of many kinds of profitable fish, in a terrible manner; and often many hogsheads of their spawn are drawn up in the trall bags, in which may be distinctly seen several thousand embryos of young fish."

Under proper regulations, the Irish herring fishery would no doubt equal, if not exceed, that of North Britain. At present no pains are bestowed in the salting and gutting of them. In some parts of the coast, they are thrown into holes dug in the earth, and there salted, from whence they are sent in bulk to Cork, and other places, to be put into barrels. Loch Swilly is one of the principal bays for the herring-fishery. The salmon-fisheries in the North of Ireland might be rendered very valuable. That of Coleraine is, perhaps, the most productive; five hundred to nearly a thousand fish being sometimes taken at a single draught. They are mostly pickled for exportation.

Fisheries of the Isle of Man.

If the information be correct which is stated by Mr Fraser, in *A Letter to the Right Honourable Charles Abbot*, nothing can more strongly exemplify the beneficial effects arising from the free use of salt without being subject to bonds, pains, or penalties, than those derived from the privilege granted by Parliament to the inhabitants of the Isle of Man, to import salt from England duty free, not only for curing fish, but for all other domestic purposes. "In the year 1784," says Mr Fraser, "I had the honour to be appointed by the Treasury to make an inquiry into the state of the revenue and fisheries of that island. I found that, at that period, without bounties on their boats, or the tonnage of their fishing smacks, or any premiums other than the free use of salt, they carried on a most extensive fishery, which employed 2500 seamen. In the absence of the herrings, the fishermen supplied the consumption of the island in great abundance with white fish; the agriculture was greatly increased, and the population consisted of 30,000 souls, having nearly doubled the number of its inhabitants in fifteen years." It further appears, from the *Report of the Committee of the House of Commons for the Fisheries in* 1798, that their boats had increased, both in number and size; that from a burden of ten to twelve tons, they had now advanced from sixteen to twenty-two tons, of which the number exceeded 350, each employing seven or eight men; that they had, besides, from forty to fifty fishing smacks, from twenty to forty tons each, the whole employing upwards of 3000 seamen, which were then equal to the number of men and boys employed in the whole of the buss fishery of Scotland, supported by bounties to the extent of L.20,000 a-year.

Foreign Fisheries.

The fish which we have said to be next of importance to the herring in point of value, is perhaps not inferior to it in point of numbers. Like it, too, the cod is supposed to be migratory, though confined chiefly within the limits of 44° or 45°, and 68° or 70° of latitude, and is found generally on banks covered with a considerable depth of water, and the deeper the water the better is the quality of the fish. It is for this reason that the great Banks of Newfoundland, those near Ireland, the coast of Norway, the Orkney, and the Shetland Islands, and other banks in the North Sea, the principal of which are the Wellbank, the Doggerbank, and the Broad-forties, are resorted to as the most favourable spots for the cod-fishery. Of all others, however, the Banks of Newfoundland are most esteemed, and are, in consequence, the general fishing grounds of all European nations, more especially the English and French. Formerly the Portuguese were the great fishers on those banks, and had their establishments on shore, but their fishery, like their commerce, fell with the fall of their naval power; and they are now content to buy their fish in their own ports, brought thither by ships belonging to foreigners. The Dutch have also for many years abandoned a fishery which they found less profitable than that nearer home. Indeed, so jealous were we once of the Dutch fishing on the Banks of Newfoundland, that Sir William Monson, in his treatise of the fishery, cautions the government to beware of letting them in; "for," says he, "they are like a serpent that never stings so deadly as when it bites without hissing." The French, by the treaty of 1763 with Great Britain, were limited in their fisheries to the neighbourhood of the small islands of St Pierre and Miquelon; and the Spaniards, by the same treaty, agreed to abandon the Newfoundland fisheries altogether.

Newfoundland Fisheries.

Since that time, however, a more formidable rival to the British fishery has started up in that of the Americans, who, of late years, have prosecuted the cod-fishery with great vigour, and with advantages which the English, with the possession of Newfoundland, are unable to command; owing, in a great degree, to the regulations by which this ancient possession of the British empire has till very lately been governed.

In a pamphlet, entitled *Considerations on the Expediency of Adopting Certain Measures for the Encouragement or Extension of the Newfoundland Fishery*, supposed to have been written by the Secretary of Lord Gambier, when Governor of that island, it is stated, that, in the year 1805, the number of vessels employed in the American fishery amounted to about 1500, carrying about 10,000 men, and that the quantity of fish caught by them amounted to 800,000 or 900,000 quintals, while the whole produce of the British Newfoundland fishery of that year did not exceed 500,000 quintals; and that the number of vessels and men employed did not amount to one-half of that employed by the Americans.

The causes assigned for this increasing success on the one hand, and falling off on the other, are as follow: The New England fishery, in all its branches, is carried on by shares, each man having a proportion of his own catch, and few or none being hired as servants on wages. By this mode the fisherman's interest being proportioned to his industry, he is actuated to labour by the most powerful incentive. The American fishermen are remarkable for their activity and enterprise, and not less so for their sobriety and frugality; and, in order to be as independent as possible on the owner of the vessel, each fisherman victuals himself, and the crew take it in turns to manage and cater for the rest. It is hardly necessary to add that men, provisions, and every other article of outfit, are procured upon much better terms in the United States than in Great Britain. But the English fishermen must not only lay in a large stock of provisions out and home at a dear rate, but must also carry out with them a number of persons to assist in the fishery, who, consequently, eat the bread of idleness on the passage out and home; for the laws by which the colony was held were such as almost to forbid residency, and those who did reside had no power of internal legislation; they were restrained from erecting the necessary dwellings for themselves and their servants; they were prohibited from enclosing and cultivating the land, beyond the planting of a few potatoes; and from the importation of provisions from the United States, except only on such conditions as were not calculated to afford the residents much relief. "From a system," says the author of the pamphlet above mentioned, "the first object of which is to withhold that principle of internal legislation, which is acknowledged to be indispensable to the good government of every community, which restrains the building of comfortable dwellings in a climate exposed to the most inclement winter, which prohibits the cultivation of the soil for food, and restricts the importation of it from the only market to which the inhabitants have the power to go,—from such a system it is not surprising that the inhabitants of Newfoundland are not able to maintain a competition against the American fishermen."

During the late war, however, when France was completely driven out of her fisheries in the Gulf of St Lawrence, and the islands of St Pierre and Miquelon, the British and the resident fisheries about equalled, in the amount of fish taken, that of the Americans in the same quarter; who employed, in the year 1812, about 1500 vessels carrying each ten men, making, in the aggregate, the enormous number of 15,000 men employed in this branch of trade alone. The English merchants of London and Poole complain, and not without apparent good grounds, of the extraordinary privileges which America enjoyed at Newfoundland; in being permitted to cure and dry her fish on shore; which privileges, granted no doubt on an expectation that such a liberal proceeding would have paved the way to a reciprocal friendly conduct on her part, became a source of gross abuses and of unwarrantable claims. By the assembling together of numerous fleets, they interrupted the occupations of our residents; they destroyed their nets, enticed away their servants, smuggled into the colony coffee, tea, spirits, tobacco, India goods, and other articles of contraband, undersold the inhabitants in stores and provisions, and added insulting and abusive language to their manifold injuries.

Since the conclusion of the war, the United States have been re-admitted, by a convention, to all their former privileges of curing and drying their fish on the unsettled bays, harbours, and creeks of Nova Scotia, Labrador, and Newfoundland; but under certain modifications, which it is hoped will prevent those abuses which existed in a flagrant degree previous to the war. The Great Bank, from its distance from the shores of Newfoundland, is of course free to all the world; but the fishery can only be successfully carried on by a constant and uninterrupted communication with the shore, and the nearer to the shore that the fish are taken, the more advantageous is it to the fishermen. The Americans, being restrained from fishing within certain limits, and having the privilege of curing and drying their fish only at certain spots on the shore, labour under a comparative disadvantage with us in this respect, which serves to balance the advantage they possess over us in others. Under this convention, the fishermen of the United States are at liberty to take fish, in common with the subjects of his Britannic Majesty, on that part of the southern coast of Newfoundland, which extends from Cape Ray to the Rameau Islands, from Cape Ray to the Quirpon Islands, on the shores of the Magdalen Islands, and also on the coasts, bays, harbours, and creeks, from Mount Joly, on the southern coast of Labrador, to and through the strait of Bellisle, and thence northerly indefinitely along the coast; and they are at liberty, also, to dry and cure fish in any of the unsettled bays, harbours, and creeks of the southern part of the coast of Newfoundland, and of the coast of Labrador; but so soon as the same, or any portion thereof, shall be *settled*, they are no longer at liberty to dry and cure fish at such portion, without a previous agreement with the inhabitants or proprietors; and, in consideration of these privileges, the United States renounce, on their part, any liberty heretofore enjoyed or claimed by their subjects, to take, dry, or cure fish, on or within *three marine miles* of any of the coasts, bays, creeks, or harbours of his Britannic Majesty's dominions in America, not included within the above mentioned limits; but may be admitted to such bays and harbours, for the purpose of wooding, watering, or repairing damages only. The mer-

chants of Poole, and others concerned in the fishery, complain of this treaty; but it appears to be well calculated to prevent those disputes and abuses which before existed, and which would probably have interrupted the harmony so desirable to be preserved between the two nations.

The importance of the fisheries on the Banks of Newfoundland, on the coast of Labrador, in the Gulf of St Lawrence, and the neighbouring islands, may be conceived, from a memorial of the committee of merchants trading to Newfoundland, addressed, in 1814, to Lord Liverpool; in which it is stated, that the catch of the French was generally estimated, at the least, at 300,000 quintals; that the Americans had reached, in 1811, nearly 1,000,000 quintals, besides fish-oil and other articles, the produce of the sea; and that the English fishery, during the American war, had increased to a degree equal to the most sanguine expectations; the export of dried cod alone, for the year 1813, having amounted to 946,102 quintals, which exceeded the shipment of the preceding year by nearly 300,000 quintals, or one-third of the catch of the whole fishery, with a proportionate increase in cod-oil, seal-skins, seal-oil, salmon, &c. amounting in value to above L. 1,500,000 sterling; employing in its transport to different markets at least 75,000 tons of British shipping, and 5000 seamen, independent of the persons actually employed in catching and curing the fish; and returning to England upwards of L.2,000,000 sterling.

These advantages, however, can hardly be supposed to continue, since the re-admission of the French and the Americans, both of whom, it is to be feared, will be able to undersell our fishermen in the foreign markets; the former from a considerable bounty being given by government on the fish caught and cured on the Banks of Newfoundland; and the latter from their nearness to the fishing grounds, and cheapness of the outfit. It has, indeed, been questioned by political economists, whether it would not be greatly advantageous to the national interests, if the capital employed in the distant possession of Newfoundland, and the fisheries contiguous to it, were engaged wholly in the fishery on the banks of our own seas, and those of Iceland and the coast of Norway, which are so much nearer home. Newfoundland, however, in spite of all the restrictions imposed upon it, has risen into a colony of too much importance to be abandoned; and its growing prosperity depends so much, it may be said indeed solely, on the fishery, that the residents, with the assistance of America, will always be able to carry it on independent of England. Much of late has, in fact, been done to better the condition of the colonists, and more will be required. Among other things, a resident-governor has been appointed, so that the inhabitants are not left for a great portion of the year, as heretofore, to administer justice among themselves, which was usually done in his absence by a surrogate, with a salary of L. 60 a-year, and magistrates, whose occupations are in some way or other connected with the fishery.

The nature, and the value of the exports from Newfoundland, will be seen from the following Table:

Estimate of the Value of the Exports from Newfoundland between the 11th of October 1801, and the 10th of October 1802; distinguishing the Countries to which they were sent, and the Remittances proceeding therefrom to Great Britain.

								Remitted to the United Kingdom, either directly, or through Foreign Europe.		
			s.	L.	s.	d.		L.	s.	
Fish,	318,396 Quintals to	Foreign Europe, at	25 per Quintal,	397,995	0	0	- -	397,995	0	
	60,230	British Europe,	18	54,215	18	0	- -	54,215	18	
	67,725	West Indies,	18	60,952	10	0				
	14,784	United States,	18	13,306	12	0				
	461,144									
Oil,	2,796 Tons,	British Europe,	L. 22 10 0 per Ton,	62,910	0	0	- -	62,910	0	
Salmon,	4,033 Tierces,	Various,	72 6 6 Tierce,	14,619	12	6	say one-half to Gr. Brit.	7,309	16	
Seal Skins,	36,000	Great Britain,	4 0 0 each	7,200	0	0	- -	7,200	0	
Furs,	value	Ditto,	-	1,980	0	0	- -	1,980	0	
Total Value at the Shipping Price in the Island,				L. 613,179	12	6		L. 531,610	14	
Freight and Insurance.										
Fish,	318,396 Quintals to	Foreign Europe, at	L. 0 3 0 per Quintal,	47,579	8	0	- -	47,759	8	L. 61,874, 11s. paid for freight on ships owned and fitted out in Great Britain, cleared out from Newfoundland for British and Foreign Europe, viz.
	60,239	British Europe,	0 1 6	4,517	18	0	- -	4,517	18	
	67,725	West Indies,	0 1 6	5,079	7	6				
	14,765	United States,	0 1 6	739	4	0				
Oil,	2,796 Tons,	British Europe,	5 5 0 per Ton,	7,689	0	0	- -	7,689	0	
Salmon,	4,033 Tierces,	Various,	0 10 0 per Tierce,	2,016	10	0	say one half to Gr. Brit.	1,008	5	
Seal Skins,	36,000	British Europe,	0 0 0 say	900	0	0	- -	900	0	
				L. 681,881	0	6		L. 593,485	0	Ships, 228
Insurance, say 5 per cent.				34,940	10	3		29,674	5	Tons, 28,132
This sum may be assured as the lowest value at market,				716,821	10	9		623,159	10	Men, 1,775
							Deduct the value of foreign salt, say 12,000 tons, at L. 1 per ton,	12,000	0	
Lowest Value of Imports and Remittances from the Newfoundland Fishery to the United Kingdom in the year 1802,								L. 611.159	10	

Fisheries.

But the following statement, taken from official documents, as the returns of the two years, ending the 10th October 1814 and 1815, will show the advanced and advancing state of the fisheries of Newfoundland, and of the colony.

Fisheries.

In 1814.		In 1815.		Difference in one year.
				Increase.
1. Number of fishing ships, European and island bankers, ships from Nova Scotia, &c. the West India and stationary vessels,	892	Number of the same description,	1,036	144
2. Burthen of the above mentioned ships,	107,998 tons	Of the same,	127,582	19,584
3. Number of men belonging to them,	6,966	Number of the same,	7,981	1,014
4. Number of boats kept by the fishing ships, bye-boat men and inhabitants,	3,241	Number of the same,	3,518	277
5. Number of men employed in the fishery and trade in ships and boats, and as shoremen,	19,295	Number of the same,	22,167	2,873
6. Quintals of fish caught and cured by the fishing-ships, bankers, and boats,	865,132	The same,	866,580	1,448
7. Exported to Spain, Portugal, and Italy, British Europe, the West Indies, British America, and the Brazils,	947,811	The same,	1,180,661	232,850
8. Tierces of salmon cured and sent to British and foreign markets,	3,425	The same,	3,752	327
9. Tons of train oil made by the fishing ships,	4,126	The same,	4,298	172
10. The number of seal skins taken,	110,275	The same,	121,182	11,007
11. Tons of seal oil made,	1,263	The same,	1,397	134

The price of cod-fish is, *per* quintal, from 15s. to 25s.; of salmon, from 65s. to 80s. the tierce; of train oil, from L. 26 to L. 34 the ton, and seal oil generally about L. 36 the ton. In 1814 the number of passengers that went over from England, Ireland, and Jersey. amounted to 2800; in 1815, they were 6735. In 1814, the population of residents amounted to 35,952; in 1815, to 40,568. In 1814, the summer inhabitants were 45,718; in 1815, they were 55,284. The number of houses on the whole island was about 5000, and the number of acres under cultivation about 6000.

Northern Whale-Fishery.

If we are to credit the information which Alfred is said to have received from Octer, the Norwegians were engaged in the whale-fishery so early as the year 890. The story, however, is not very probable. The first people known to carry it on as a regular occupation were the Biscayans, who, when the English first embarked in this fishery, towards the end of the sixteenth or beginning of the seventeenth century, were always engaged as part of the crew. It continued to be carried on by the Russian and the East India Company for some years, but with no great success; sufficient, however, to induce the Dutch to attempt it. After them came the Danes, the Hamburghers, and the French, all of whom were finally driven out, or nearly so, by the Dutch. At this time the whales were so plentiful in all the bays of Spitzbergen, that the practice then was to boil the oil on shore; but when, in process of time, these large fish became more scarce, or were scared from the shore, the fishery was carried on at a distance from the land, when it was found necessary to bring home the solid blubber in casks. This circumstance was a further discouragement to the English merchants, who, for more than a century, relinquished the whale-fishery altogether. The South Sea Company, however, revived it in the early part of the eighteenth century, when Parliament granted a bounty of 20s. *per* ton on all British ships of 200 tons and upwards, which was afterwards increased to 40s. *per* ton. This, however, by 26th Geo. III. was again reduced to 30s., but several encouragements were added for the prosecution of the whale-fishery by able and expert seamen. The harpooners, the line-managers, and the boat-steerers, were not only protected from impress during the voyage, but were allowed to engage in the coal and coasting trade unmolested in the winter months, with other privileges granted by that and subsequent acts.

The decline of the Dutch whale-fishery kept pace with the decline of their herring-fishery; and from the same cause, the decline of their maritime power, which had reciprocally supported each other. The English now began to carry on the fishery with great vigour on both sides of Greenland, so as to make it an object of great national importance, both as a nursery for excellent seamen, and as a source of public wealth. On the termination of the late war, the owners of ships employed in the northern whale-fishery, alarmed at the apprehension of the Dutch and French reviving the fishery, but more so at the opening of the ports on the continent, put forth a statement of the amount and extent of the fishery, from which it would appear that 7500 men and boys are employed in it as sailors; that, by act of Parliament, the owners are required to take six apprentices for each ship of 300 tons, by which about 900 youths are constantly training for the future service of the country, and that about 200 of them complete the term of their servitude every year, when, such as are not boat-steerers, harpooners, or line-managers, become liable to serve in the navy; that not less than 300 men are also taken annually from employments on land, or from the river trade, most of whom, after two years, are competent to serve in

his Majesty's navy; whom, with the apprentices and unprotected seamen employed, make a total of 4000 effective men subject to impressment.

It is further stated by the owners, that at the termination of the war, no less than 148 valuable ships, comprising 50,000 tons, and engaging a capital of L.2,000,000, were employed in the Greenland and Davis' Straits fishery; that the provisions for the voyage amount to about L. 600 for each ship, forming a total of L. 90,000, wholly furnished from our own markets, affording encouragement to agriculture, as well as to the various descriptions of tradesmen through whose hands the provisions are supplied; that the whole produce, therefore, of the fishery may be considered as gain to the country.

As, however, foreign ships may be sent to the fishery on more moderate terms than the English can supply theirs, and as the King of the Netherlands has offered considerable bounties to ships proceeding to the northern fisheries, all hope appears to be cut off, that Englishmen will ever be again permitted to contribute to the supply of foreign markets with whale oil, but must look to the consumption of Great Britain alone in future. It is therefore suggested by the ship-owners, as some relief, that the enormous quantity of foreign rape-seed, which has recently been imported into this country, nearly duty free, should be checked; and that, by laying a sufficient duty on the importation of this article, the protection of government would be beneficially extended at once to the encouragement of the British agriculturist, and the relief of the Greenland trader. No reasonable objection, it is stated, can be made to such a measure, unless from a mistaken apprehension with regard to its effects on the price of woollen cloths; which is so inconsiderable, that a duty of L. 12 *per* last on foreign rape-seed would not occasion an advance of more than about one farthing and a half *per* yard on narrow cloths; and that, in fine cloths, Gallipol oil alone is used. This appears to be reasonable enough; but the owners of the whale-fishing ships had another and a more formidable rival in the market in the lighting of the streets of London and other great towns with Gas. It was stated, that for every three parishes in the metropolis thus lighted, five whole ships would be thrown out of employ; and that if all the parishes in London, Westminster, and Southwark, should be so lighted, it must entirely put an end to a trade which employs 10,000 seamen, 2000 apprentices, and 2000 landsmen, training constantly to the sea, and which affords occupation to 100,000 individuals. The Gas Company say, on the other hand, that the expenditure of coal will amply compensate, in a national point of view, for any loss the Greenland trade may sustain, by the additional quantity of shipping employed in bringing the coal to the metropolis. This, however, is an exaggerated statement; but as whale-oil is now employed for so many more purposes than formerly, and even in the manufacture of gas, the lighting of the streets, even if general, will probably not injure the fishery to any great extent; though the lighting of shops and private houses, should the practice become general, must seriously injure the South Sea fishery, as sperm was very commonly used for domestic purposes.

The state of the Northern Whale-Fishery will be seen from the following account of the number of fish and produce of oil, brought by the ships of the several ports of Great Britain from the Greenland and Davis' Straits Fishery, in the year 1814:

Ships.		Fish.	Oil.
58	Hull,	697	7326
20	London,	367	2981
1	Lynn,	25	187
1	Grimsby,	7	85
8	Whitby,	172	1381
5	Newcastle,	49	628
2	Berwick,	16	178
10	Leith,	73	1021
1	Kirkaldy,	7	100
8	Dundee,	61	955
3	Montrose,	47	306
2	Liverpool,	43	437
13	Aberdeen,	178	1733
7	Peterhead,	164	1390
2	Banff,	30	245
1	Kirkwall,	10	120
1	Greenock,	35	245
143	Total,	1981	19,408

50 Men in each ship.

7150	Number of men employed annually in the northern whale fishery.			
19,408	Tons of oil, at L. 38,	L.737,504	0	0
647	Ditto whale-bone, the produce of 1981 fish, at L.80 *per* ton,	51,760	0	0
	Total amount of the produce of the Northern Whale-Fishery, in the year 1814,	L.789,264	0	0

Southern Whale-Fishery.

The statutes of 35th Geo. III. c. 92, and 42d Geo. III. c. 18, regulate the proceedings, and prescribe the conditions on which premiums of L. 100 to L. 400 may be claimed by each of sixteen ships employed in this fishery. Though less important, in a national point of view, than the northern whale-fishery, the number of ships and seamen employed in it are very considerable. They are fitted out mostly from London, and amounted, in the year 1815, to 107 ships, comprising 32,100 tons, and manned with about 3210 seamen; and their return cargoes were calculated to be worth about L.1,070,000 sterling.

The returns of the two fisheries, then, will stand as under:

	Ships.	Men.	Value.
In the northern fishery,	143	7150	L.789,264
In the southern ditto,	107	3210	1,070,000
Total,	250	10,360	L.1,859,264

These statements of the productive value of the foreign British fisheries may probably approach pretty nearly to the truth; but the reports of the home fisheries are too vague to afford any thing like an accurate estimate. If we should take the 120,000 tons of fish said to be imported annually into the metropolis, at the low average rate of threepence a-pound, and allow, for the rest of the consumption in the British empire, only one-half the quantity consumed in and exported from the capital, and half a million for the export produce of the herring and cod and ling fishery, we shall have the productive value of the whole as under:

The Greenland and South Sea fisheries,	L.1,800,000
The Newfoundland fishery, -	1,500,000
The herring cod, and ling ditto for exportation, - -	500,000
The consumption of London and re-exportation, - -	3,000,000
Ditto of the rest of Great Britain,	1,500,000
	L.8,300,000

And, on a general review of the number of seamen, landmen, and boys employed in the fisheries, that is to say, *on the water*, it would not appear to be too high an estimate to reckon them at 120,000. (K.)

FLINTSHIRE, a county of North Wales. It consists of a narrow tract of land, about twenty-eight miles in length, varying considerably in its breadth, in no part exceeding ten miles. The Irish Sea partly bounds it on the north; the river Dee and a part of Cheshire on a part of the north and on the north-east side, and the county of Denbigh on the south and west sides. A portion of the county is detached from the rest by the interposition of a part of Denbighshire. It is divided into five hundreds, viz. Coleshill, Maylor, Mold, Prestatyn, and Rhyddlan. The extent in square miles is 309 or 197,760 acres. By the census of 1801, the number of inhabitants appeared to be 39,622; and by the last returns of 1811, they amounted to 48,100, or one person to four acres and a half of land. Flint, the county town, in which the election for the Member of Parliament is held, and in which the county jail stands, is a small place containing only 1433 inhabitants. The river Dee formerly washed the walls of its ancient castle, but has of late considerably receded, and it has now no means of carrying on commerce by sea, except in very small vessels; and it is necessary that those should be so constructed as to remain dry, during low water, without injury. It derives some share of prosperity from having recently become a fashionable sea-bathing place resorted to by the gentry of Cheshire, Shropshire, and some other adjoining districts. Mold, the town at which the assizes are held, has rapidly increased, owing, in some measure, to the establishment of very extensive mills for spinning cotton in its vicinity. The town, including the whole parish of which it forms a part, contains now a population of 4235 souls. The city of St Asaph is neither distinguished by its extent nor the beauty of its buildings, and contains only 1520 inhabitants. Its situation, on the side of a hill, the summit of which is crowned by the cathedral, and between the rivers Clwyd and Elwy, is very imposing, and strikes the traveller forcibly as he approaches it. Though the immediate vicinity of this city has a sterile appearance, yet the views near it in one direction over the enchanting vale of Clwyd, and in another over the diversified landscape which terminates with the ruins of the castle of Denbigh, present to the eye of those who have a taste for beautiful scenery a most delightful treat.

The diocese of St Asaph extends nearly over the whole of the county, and from several livings which are held *in commendam* by the bishop, is a very lucrative preferment. The Episcopal chair has, since the Reformation, been filled by many prelates of most distinguished character. Morgan was translated to this see in 1601, as a reward for his eminent acquirements as an oriental linguist. He was employed in translating the sacred writings into the Welsh language, as well as in a part of the English edition commonly called "Queen Elizabeth's Bible." Dr Isaac Barrow, uncle to the celebrated mathematician, was eminent for his munificence to the see, as well as for his profound learning. The pious Beveridge, for a few of his last years, was Bishop of St Asaph; and the chair has been since filled by the amiable and learned Shipley, and the powerful and energetic Horsley. The cathedral has been of late much improved and beautified by the bounty of Bishop Bagot, and the liberal contributions of the nobility and gentry of the county. It was built about the year 1480, upon a foundation of much more ancient date; it is in length, from east to west, 179 feet, and in breadth, from north to south, 108 feet. The most important place in this county, from its wealth, its population, and its continued increase, is the town of Holywell, deriving its name from the well of St Wenefrede, which, in the ages of credulity, was supposed to possess miraculous powers of healing, but has of late been applied to better purposes than nurturing such superstitions. As there are many Catholics in Flintshire, the belief in the miraculous power of this spring is not wholly extinct, nor have the pilgrimages to it altogether ceased. So late as 1805, a very zealous attempt was made to revive the credit of the Saint, and establish faith in the wonderful cures achieved by bathing in her well. A case was narrated, accompanied with certificates, and a challenge given to all who doubted of the miracle, by an appeal to facts "as stubborn things;" an appeal which, however it might confirm the faith of her votaries, had no influence beyond that narrow circle. The number of inhabitants within the town of Holywell at the census in 1811 was 6394, and they have continued to increase from that period to the present time.

The productions of Flintshire that deserve most notice are the minerals, whose preparation gives employment to a considerable portion of the population.

Flintshire. Coals are found in abundance, chiefly near the banks of the Dee, and in other parts near the surface, and in very thick seams. The city of Chester is principally supplied with its fuel from hence, and considerable quantities were shipped for Ireland before the change in the course of the Dee, and before the coal-mines of Lancashire and Cumberland had attained their present extent. Lead is most copiously raised, from a very extensive mining tract, near Holywell, and in the same excavations is raised most excellent limestone, applicable to the purposes of agriculture as well as building, and so hard, that it will bear a high polish, and is a kind of marble. Below the limestone is found petrosilex, which is ground and becomes very valuable in the manufacture of earthenware. Calamine is found in considerable quantities; a part is exported, but much is used within the county in the preparation of brass. The lead is divided by the miners into two clases: that called cubic, or dice ore, is generally used in glazing earthenware; the other called white, or steel-grained ore, is principally cast into pigs for distant consumption; this latter contains a portion of silver, sufficient to defray the expence of separating the metals, and several thousand ounces have been annually extracted. The workmen in the lead mines are visited with maladies that both embitter and shorten their lives.

The manufactories of this county are very considerable, and have taken that course which the natural productions have indicated. Brass is made by the mixture of copper with calamine, and formed into the different shapes to fit it for domestic and commercial purposes. Copper-works, under the Pargs-mine Company, are constructed, and produce large quantities of copper sheathing, bolts, nails, and other necessaries for naval equipment, as well as brass wire and minuter articles. The potteries are very extensive, and manufacture large quantities of the inferior kinds of earthenware, which supply the consumption of a great part of Wales, and export considerable quantities to Ireland. Besides these manufactories which the minerals have introduced, the fine stream that issues from the well of St Wenefrede has attracted the attention of cotton-spinners, who have erected a most powerful mass of machinery. They carry on the operations of carding and spinning cotton to a great extent.

The agriculture of this county is in a neglected state, and draws to it a very insufficient portion of its capital; hence few improvements have been adopted of late years. Near the banks of the Dee is some good corn land, of a clayey texture, on which, after a fallow, good wheat is grown. The meadows, in this part, produce excellent herbage, and the cows afford the best possible butter. The northern part of the county is generally a level country, and well calculated for the growth of wheat, oats, and beans. On the higher lands rye is cultivated, but those lands are very imperfectly tilled, and are nearly destitute of manure. The rich vale of Mold forms a striking contrast with the more mountainous parts of the county, and yields very good butter, corn, and meat.

The ruins of ancient edifices, and other antiquities, are numerous, and invite the attention of the antiquarian. A few years ago, whilst digging for the purpose of laying the foundation of a copper work, a Roman *hypocaust*, or hot bath, was discovered, furnished with numerous flues, covered with tiles of a red colour; a clear evidence that the county had been anciently inhabited by some persons acquainted with the luxuries of Rome.

Flintshire ‖ Florida.

Few counties, for the extent, contain so many gentlemen's seats as Flintshire: the most remarkable are Mostyn Hall, Sir Thomas Mostyn; Pengewern, Sir Edward Pryce Lloyd; Boddlewyddan, Sir John Williams; Kinmael Hall, Reverend Edward Hughes; Gwernhailed, Philip Lloyd Fletcher, Esq.; Hanmer Hall, Sir Thomas Hanmer; Downing, David Pennant, Esq.; Halken, Earl Grosvenor; Adwynt, J. Roberts, Esq.; Llewenny Hall, Lord Kirkwall.

See *Agricultural Survey of North Wales.*—Wynne's *History of Wales.*—Pennant's *Tour in Wales.*—Aikin's *Tour in North Wales.* (W. W.)

FLORIDA, a district of North America, belonging to the crown of Spain, having been ceded to it by Great Britain at the peace of 1783. The history of its discovery and early establishment being narrated in the *Encyclopædia*, we confine ourselves to such notices of it as were then omitted, or as subsequent events have rendered interesting.

When, in 1763, Spain gave up Florida in exchange for Cuba, the British government divided it into two provinces, distinguished by the names of East and West Florida. East Florida is bounded on the north by the river St Mary, in 30° 35′ north latitude, which divides it from Georgia. Its eastern boundary is the Atlantic Ocean to Cape Florida in latitude 25° 55′ north, when, terminating at that point, it bends to the northward. Its western boundary is the sea in the Gulf of Mexico to the latitude 29° 30° north, from whence the river Apalachicola forms the line which separates it from West Florida, till it meets the confines of Georgia. The province, in shape, resembles a wedge, the base line towards Georgia being 160 miles; and the perpendicular line from north to south being 350 miles. As the whole province is a peninsula, it presents an extended point to the sea, and from its position, as well as its formation, is calculated, when peopled, to enjoy a considerable share of navigation; but the want of secure bays and harbours, and the dangerous bars at the mouths of its rivers, forbid any very sanguine expectations of its speedy population being realized. East Florida.

The best navigable river on the eastern side of the province is St Mary, its northern boundary. It is navigable, however, but for a short distance. The depth of water in the bar is sufficient to admit vessels drawing 16 feet, and at spring tides vessels drawing 20 feet water may enter, and when within they are in perfect safety. In the centre of this river, Amelia Island, which belongs to Florida, commands the ascent and anchorage. A small fortress and a miserable town called Fernandina, are all that this island contains. It was for a short time occupied by a piratical banditti, who assumed to be South American republicans, and was at last seized by the United States troops, under pretence of dislodging the depredators. Rivers.

Florida.

The river San Juan is about half way between St Mary's and St Augustine. Its entrance is difficult, and will not admit of vessels drawing more than twelve feet water, and even with that draught, it is a very perilous navigation.

As most of the plantations, when the English possessed the province, were either on the banks of this river, or on Rio Pablo, which empties itself into it, it became the most valuable part of the province; and the town of St John's, built principally during the American war by English emigrants from the revolted states, was growing into some consideration, when its progress was checked by the peace of 1783, and the consequent removal of the British settlers to the Bahama Islands. It is now a place of little importance, and the number of its inhabitants has been fast diminishing.

City of St Augustine.

St Augustine, the capital of East Florida, is built on an inlet behind the island of St Anastasia, which forms an excellent harbour, but difficult of access. Vessels of more than ten feet draught of water cannot enter even at spring tides, and when of that draught they seldom escape without striking on the bar; the greater part of the cargo is therefore usually landed by lighters before an entrance is attempted. The entrance is defended by a fort on Anastasia Island, and by a strong fortress on the main land. This fort, St Mark's, was originally built by the Spaniards, but considerably improved and strengthened by the British. It is built of stone, has four bastions, the curtains between each one 180 feet in length, and the rampart is 20 feet in height. The buildings are very strongly constructed, they are partly casemated, and mostly bomb-proof. The city is defended by a double row of lines which stretch across the neck of land that connects it with the country; and thus, if it were worth attacking, with a sufficient garrison, it is capable of an obstinate defence. The town contained, when the Spaniards held it, about 4000 inhabitants of various descriptions, including a garrison of 400 soldiers. When, in 1769, it was ceded to Great Britain, the inhabitants, with that attachment to the mother country, its religion, and its government, which Spaniards, and their descendants, have preserved in every part of the globe, left the province, and settled either in Cuba, Hispaniola, or Louisiana. Only two families remained under the British government, and one of them in the distant woods.

Soon after possession was taken by the British, various plans were projected for settling the province. The late Mr Denis Rolle, father of the Peer of that title, established a large plantation on the river St John. The Beresford family of Ireland attempted another establishment on the same river. The reports of the healthiness and fertility of the country attracted various settlers under the auspices of these patrons, but the projects were ultimately unsuccessful, and were finally abandoned. The Grenville family adopted a more splendid project. Under their patronage, Dr Turnbull collected numerous emigrants from the island of Minorca, and conveyed them to East Florida. They were bound to serve for a stipulated term of years, by articles signed before they left their native island. A settlement was made at the mouth of the river Musquito in latitude 29° 45′, and called New Smyrna. The situation was supposed to be very favourable for the growth of silk and vines, to the culture of which the emigrants from Minorca had been accustomed. Considerable sums had been expended in this establishment, when discontent arose among the settlers, and after much altercation, they all abandoned the rising plantation, and removed to the capital. It is needless to add, that the project thus terminated ruinously. In subsequent suits in the courts of law, Dr Turnbull was unsuccessful, and the Minorquins declared to be freed from their engagements. By the failure of this great project the settlers became dispersed, and as they were mostly married, multiplied very rapidly, and thus the colony was growing in population.

Florida.

When the revolutionary war took place, many royalists repaired from Carolina and Georgia to Florida, and further increased the numbers and the wealth of the province. In this condition, in 1783, it was ceded to Spain, in exchange for the Bahama Islands, which that country had recently conquered. As the colonial laws of Spain neither admit foreigners, except under certain conditions, nor allow any but Catholics to live on their transatlantic dominions, the plantations were broken up; the British inhabitants and their slaves removed to other countries; and only the Minorquins and their descendants remained to people the country, thus again become subject to the Spanish court. They are said to have increased very considerably, and now to amount to upwards of 5000 souls. Some few Spanish families have also removed to East Florida; but altogether, the population, including imported negroes, is not nearly equal to what existed when the British relinquished the settlement.

The city of St Augustine consists of three long streets parallel to the shore, a square or parade, and several streets that cross the principal ones at right angles. There are two churches, but neither of them large or highly ornamented. The state-house built by the British, now called the Cabildo, is a handsome building of stone, and displays considerable taste. The government-house is large and convenient, but built without any regular plan, and has by no means a prepossessing appearance. The abundance of orange trees which are growing in the town, and which are in constant bloom, and have green and ripe fruit on them through the whole year, give a pleasing appearance to this place. It is badly supplied with water, as all the springs are somewhat brackish.

There is no other place in East Florida that deserves even the name of a town. Matanzas, about twenty miles south of St Augustine, consists only of a few scattered plantations; and New Smyrna has, by the desertion of its Minorquin settlers, become almost without inhabitants. There are no settlements to the southward of New Smyrna, and only a few tribes of scattered Indians resort there for the chace. Occasionally, temporary habitations are constructed on the shore by people from the Bahama Islands, who repair thither to catch turtle, or to employ themselves as *wreckers*, by saving what they can from the numerous vessels that are stranded in their

Florida. passage from the West Indies, through the Gulf of Florida.

On the western side of East Florida, though several considerable rivers empty themselves into the Gulf of Mexico, no settlements have been formed, except at the mouth of the river St Mark, and that, though protected by a fort, has gone to decay, and is now nearly deserted.

Climate. The climate of East Florida is perhaps the most pleasant and salubrious of any in the globe. It is within the reach of the tropical winds, which, in the midst of summer, temper the heat, and give a daily freshness to the air. In winter frosts are scarcely known, and snow and ice, if they are occasionally experienced, disappear with the first rays of the sun. No country can be more free from fogs, and other noxious exhalations; and hence the troops quartered here, as well as the inhabitants, have experienced a portion of health and longevity scarcely known in any part of the western continent.

Soil and Productions. The soil of East Florida on the sea shore is generally sandy, and covered with tall pine trees, without any underwood beneath them. It is, however, intermingled with swamps, filled with almost impenetrable woods of every description, and with extensive savannahs, well calculated for the cultivation of rice. The fine barrens, as they are called, yield with little labour vast quantities of turpentine, tar, and pitch. The turpentine exudes by the heat of the sun alone from the body of the trees, whose bark is pared away to admit of the action of the sun upon the woody fibres. It is collected by the slaves from small boxes cut in the tree, near the bottom, into which it runs; it is thence carried to a general reservoir, from which the casks are filled for exportation. In extracting tar, the pines are cleft into small pieces; a kiln is constructed with them on a grating of iron bars laid over a hole in the ground; by means of a gentle heat the tar is extracted, and runs into the pit. The pitch is made by a simple process: two or three red-hot cannon-balls are thrown into the pit in which the tar is deposited. A fire is by that means kindled in the mass of tar, which burns with a prodigious noise, and produces a very thick smoke. The burning is continued till the moisture in the tar is consumed or dissipated, when the fire is extinguished by laying hurdles over the pit, and covering them close with sods of turf. When the substance cools it becomes hard and shining, and requires axes to chop it out of the holes. After various experimental projects on the vine, the mulberry, and the indigo plants, the English settlers, from the year 1776 to 1783, almost confined their agricultural labours to the production of these naval articles, the prices of which had been increased during the war that raged in those years. The exports consisted then principally of the naval stores, with the addition of some peltry collected by the Indians in the interior.

Soon after 1783, the Spanish settlers, increased by recruits from the United States, and stimulated by the example of the citizens of Georgia, began to cultivate cotton. The northern part of the province was found admirably calculated for its growth; and hence attention and capital was attracted towards the banks of the river St Mary, and the boundary beyond that river, which divides it from Georgia. By the laws of Spain, her colonies can only export their productions to the northern country, and in ships of that nation; but the facilities of conveying the cotton-wool grown on the Spanish side, to the American side of the boundary, lessened this impediment to the cultivation of the valuable production best suited to the soil and climate. The navigation of the river was common to both nations, and the ships loaded with cotton from the American side of the river had their cargoes principally furnished to them from the growth of the Spanish territories. This contraband trade, which no laws could prevent, gave a great encouragement to the settlements on the northern part of the province, and it has consequently become both the most populous and the most wealthy. Attempts have been made to cultivate wheat, but hitherto without success; probably owing to the experiments having been tried on the sandy soil near the shores, and not on the clay lands on higher elevations in the interior. Maize and rice are abundant, and form the principal food of the inhabitants.

Quadrupeds. The woods abound with troops of wild horses, which traverse the whole peninsula. They are of small size, but strong. They are easily taken and rendered tractable by the Indians, who bring them to the European establishments, and exchange them for such weapons as they want. Their value is so trifling, that a good saddle may be exchanged for twenty. Abundance of wild hogs are running over the country, especially over the islands on the sea shore, and near the borders of the lakes. They are not indigenous, but evidently of European origin, and seem to have changed their nature very little by having ceased to be domesticated. Numberless deer inhabit the woods; they are killed by the natives principally for the sake of the skins; but when any of the Indian hunters take them near the settled parts, they sell the flesh for food to the inhabitants, who can frequently, for a knife not worth in Europe sixpence, or for some other article of equally diminutive value, obtain the whole carcase of a deer.

Black bears are numerous; they are of a very small size, very timid, never attacking but flying from man. The hunting them is a diversion to the inhabitants, and their flesh is considered a great dainty. There are but few cows, and still fewer sheep, and none of either in an unreclaimed state. Goats have not been introduced.

Fish. The sea coasts, the rivers, and the lakes, abound with every variety of fish, and they furnish food to the greater proportion of the people, especially on fast days, and in Lent, which the Minorquins, as well as the Spaniards, observe with great rigidity. The rivers and lakes swarm with alligators, who feed most voraciously on the innumerable fry of smaller fish. The abundance of these smaller fish is a most singular fact. The sea shore abounds with sharks, who, like the alligators, find a supply of food by preying on the smaller tribes, who, when pursued by those voracious monsters, and ascending the creeks to parts where they suddenly contract, so fill the water as to impede the passage of a boat. In some in-

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stances, where the contraction of the stream is very sudden and very great, those smaller fish have been seen so closely crowded as to become a mass actually filling the channel, and even rising, so wedged together, above the surface of the water.

Though the land near the shore is level, and the soil sandy, yet, on proceeding to the interior, the pines are no longer seen, the soil is richer, and mountains gradually rise. On the coast, the tuna or prickly pears form, with aloes, the sole fences; in advancing inland, the live oak, the hickory, chesnut, and walnut trees appear, and there are abundance of cabbage trees.

Birds.

The bird tribes are very extensive and numerous in both the Floridas. Wild ducks and wild geese are found in prodigious flights; wild turkeys are plentiful, of a very large size, some of them weighing more than forty pounds. There are, besides, bustards, herons, cranes, partridges, pigeons, hawks, and macaws, and many of the smaller kinds, thrushes, jays, larks, and sparrows.

There are some considerable lakes in the centre of the province; the most beautiful is that of St George. It is near the source of the river St Juan, is fifteen miles long, about ten in its mean breadth, and from fifteen to twenty feet in depth. In this lake are some islands; the largest of them is two miles broad, has a most fertile soil, and contains vestiges of an ancient Indian town of considerable extent. In the centre stands a lofty mound of earth, of a conical shape, from which a causeway is carried to the shore through groves of magnolias, oaks, palms, and orange trees. From the fragments dug up, the place is supposed to have been very populous. It was probably a station of the Apulachian Indians, whose remains show some approaches to civilization.

West Florida.

West Florida, in its productions, in its soil, and climate, so nearly resembles East Florida, that it will admit of a more brief description. It is bounded by East Florida to the eastward, by the Gulf of Mexico to the south, to the north its boundary is the 31st degree of north latitude from the Apalachicola to its western extremity, where the river Iberville separates it from Louisiana. The province is about 120 miles in length, from east to west, and from 40 to 80 in breadth; and, consequently, its longest side is towards the sea. Pensacola, the capital, is in 30° 20′ north latitude, and 87° 12′ west longitude from London.

City of Pensacola.

It is situated on the western side of Pensacola bay, which is a most excellent harbour, safe from all winds, has a good entrance, secure holding ground, in seven fathom water, and vessels drawing 20 feet water may enter it at all times. Indeed there is very little tide, the greatest rise not exceeding one foot. The entrance into the bay is defended by a fort on the Island of Rosa, and by a battery on the opposite shore. The city is delightfully placed on the sea-coast, extending a mile in length, and a quarter of a mile in breadth. It was fortified by the English, though not in a very perfect manner; but, being well garrisoned, it withstood a long siege from a numerous army under the Spanish General Galvez, in the year 1781. Owing to the principal magazine, which was supposed to be bomb-proof, having been entered by a shell, an explosion took place, by which almost the whole powder of the garrison was destroyed, and it was compelled to capitulate. The trade, whilst it was in possession of the British, was considerable; its exports amounting to about L.100,000 annually, and its imports were nearly of the same value. Besides the productions common to both Floridas, this division furnished considerable quantities of dyeing woods, and several medicinal plants, especially snakeroot and ginseng. The quantity of peltry collected by the Indians, and brought to Pensacola, was much more considerable than that which found an outlet by St Augustine, St John's, and St Mary's rivers.

When Pensacola fell into the hands of the Spaniard, and possession of it, as well as of East Floridas, was confirmed by the treaty of peace in 1783, the greater part of the inhabitants left the country, and settled either in the United States or the British Islands; and few Spanish settlers having fixed their residence in it, the town and province have, ever since the change, been in a desolate state. The expences of maintaining the governments of the two Floridas by Spain has so much exceeded the revenues, that they have required remittances from Mexico annually, to the amount of near 300,000 dollars.

Mobile.

Mobile, with the district around it, was seized by the American Government in the year 1810, and though the right to it depended on the unsettled question of boundary, it may be noticed here, with more propriety than under the article Louisiana, to which country the Americans asserted that it belongs. It was, when held by the British, a place of considerable importance, and most rapidly increasing. It is well situated for commerce, as the Alabama river and district must have all their productions pass by it to reach the ocean. Though vessels of large size cannot reach the town, yet they can anchor securely within the river seven miles below it; and it has the advantage of being connected by boat navigation with Tennesse by the rivers Alabama and Tombecbee, which are navigable 300 miles above the town. These advantages were lost to the place, whilst under the Spanish Government; it had rapidly decayed, and was rather a harbour for outlaws and contrabandists than a mercantile or agricultural colony. In 1810, when the events in Spain made it doubtful what government was to rule the peninsula, the inhabitants of Mobile showed a disposition to set up a government of their own. Folch, the Spanish commander, was unable to restrain the inhabitants, and he relinquished his power to the United States. Since that period Mobile has continued to increase, and as it is now assumed to be, and practically is a part of the States, it may, at no very distant period, become a place of considerable importance.

Indian Tribes.

The Indian tribes bordering on Florida are the two nations of the Upper and Lower Creeks, the Aconies and the Seminoles. When, in 1781, the Spaniards conquered West and menaced East Florida, all these tribes were resolutely engaged in the English cause. They have, like the rest of the Aborigines, considerably diminished in numbers, as the more civilized population has approached nearer their villages. It is said, however, that these tribes

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when united can muster near two thousand warriors; but in this enumeration are included many fugitive negro-slaves from the States that have joined them. The inhabitants of the United States, in all the southern parts, from the feelings which their system of negro-slavery has created towards all that are not of the European complexion, too frequently treat the Indians with unfeeling cruelty. The State governments to the southward are all composed of individuals who are masters of slaves; even the Congress has a majority of its members masters of slaves; and the President, ever since the establishment of their constitution, has been chosen from the slave-owners with but one exception. Coloured people, by such men, are scarcely considered as human beings. No sympathy is felt for their sufferings, and no redress is afforded to their complaints. They are treated with oppression, and they retaliate by barbarity. Peace can never be of long duration between such parties, and the justice of their cause can never be impartially ascertained. The opponents of the Indians who alone have communication with them, exclusively possess the faculties of reading and writing; they alone have the power of printing their statements; and consequently of dressing them in such colours as best suit their own views.

Conduct of the United States, in regard to Florida.

As in the views of the United States the possession of the Floridas was important, they have never ceased to desire it since their acquisition of independence. No pretext either for exchanging or seizing these provinces presented itself till the Government of France became masters of Louisiana. Bonaparte having induced the imbecile cabinet of Spain to cede to him the province of Louisiana, and knowing the eagerness felt in America for the extension of a territory already too extensive, bargained with the United States for the province, before the treaty with Spain was completed. The Government of America paid the price for the stolen track, and thus became accomplices with him who had committed the fraud. A French Commissioner, M. Laussat, received the surrender from the Spanish Government, and instantly delivered over the province to the officers of the United States. No dispute then arose about the boundary. The Mississippi and the Iberville had been considered by the English, the Spaniards, and the French, as the line which divided Louisiana from Florida. Under this conviction, France received it from Spain, and with the same conviction it was delivered to America. When the United States had thus gained Louisiana, the desire for Florida became more intense; and on the most flimsy pretences, claims were set up to the track of country included between the Iberville and the Perdido, which the Americans asserted was a part of Louisiana. Appeals were made to the Government of France as to their understanding of the limits which they had received and transferred. The answer of France was, that they had only received the country up to the Mississippi, and that the district between that river and the Perdido had not been included in the cession made to them by Spain, but continued, as it had previously been, a part of Florida, which Spain was to retain. Though much discussion between the two Governments was carried on, from the time when Louisiana was transferred, no steps had been taken by America to enforce her claims; but when the Peninsula was overrun by the armies of France, and no government recognised by America existed there, the territory in dispute was occupied by the Americans, as we have before stated, with the concurrence of Folch, the Spanish commander at Mobile.

When the monarchy of Spain was restored, negociations on the subject were renewed. The disputed territory had been consolidated with the United States; but the remainder of the Floridas, which were in the possession of Spain, and to which not even the shadow of a claim could be urged by the Americans, continued to excite their cupidity. During a period of the war which France and Spain had carried on against England, depredations, as the Americans asserted, had been committed on their commerce, by privateers belonging to Frenchmen, who had captured their ships, and carried them into Spanish ports, where they had been condemned as legal prizes, before the consuls of France, who exercised judicial authority within the dominions of Spain. The Americans demanded from Spain, in no very decorous terms, compensations for the losses their citizens had thus sustained. The Spanish court replied, that they were no parties to the injury; that compensation, if any, was due from France; that the aggrieved Americans had, by appealing to the courts of revision in France, acquiesced in the construction put on these transactions by the Spanish court; and that the courts in Spain could take no steps to investigate the validity of the complaints, or to ascertain the quantum of injury sustained, as all the documentary evidence was in the possession of the French judicatures. The minister of Bonaparte asserted, that, in the negociations for the sale of Louisiana, a compensation had been made to America for these depredations; and that she could consequently have no claim on that account to urge either on France or Spain.

As long as Bonaparte ruled, the claims of America could gain no attention from him; and Talleyrand, who had been the minister that carried on the negociation, repelled, in the most indignant terms, every suggestion, and even intimation, that any account respecting these captures had not been finally adjusted. When Bonaparte was dethroned, and when Spain was entangled by the disputes with her colonies, America urged her claims with renewed pertinacity; and intimated that the Floridas might be ceded as a compensation, and that the losses, alleged to have been sustained by the merchants, should be adjusted by the American government. As Spain was unwilling to acquiesce in this unjust pretension, the Americans, to quicken her, affected to deliberate on the propriety of recognizing the revolted colonies of Spain as independent states, and sent Commissioners to different parts to ascertain the condition of those countries. The Spanish envoy, alarmed by these feints, was induced to yield, and to acquiesce in the unjust pretensions of America, and at length concluded a treaty ceding the Floridas. Whilst these negociations were carried on,

however, Pensacola had been captured, and arrangements made for the seizure of St Augustine, by an American officer, who, having been sent to fight the Seminole Indians, had raised and officered an army, without any authority but his own, and in opposition to the laws of the United States.

It appears by the very able report of a Committee of the senate of the United States, that General Jackson was ordered by the war department, to take under his command the militia of the contiguous states, to attack and disperse the Seminoles, and, when peace was concluded, to dismiss the militia. That officer, however, raised and officered a reguiar army of 1800 men, but called out no militia; he was joined by Generals Gaines and M'Intosh with 1500 more, and, with this force, was soon enabled to disperse the Seminoles, whose numbers, when collected, amounted only to 800 or 900 warriors. When peace was thus gained, instead of obeying his instructions, and dismissing his troops, General Jackson advanced into the Spanish territory. The government had given orders, that, if the Indians should retire under the protection of a Spanish garrison, the American army was not to follow them, but to report it to the executive, and wait for its instructions. Jackson wrote to his government on the 26th April 1818, " that the Indian forces had been divided and scattered: cut off from all communications with those agents of foreign nations, who had deluded them to their ruin, and had not the power, if they had the will, of annoying our frontier." He adds, that, "after making all necessary arrangements for the security of the positions occupied, and detaching a force to scour the country west of the Appalochicola, I shall proceed direct to Nashville, as my presence in this country can be no longer necessary." Whilst composing this dispatch, however, the arrangements were proceeding for attacking the garrisons of Spain. His heavy artillery was moving from Mobile towards Pensacola, and the general, with 1200 men, joined it in about three weeks from that period, before that place. The opposition was trifling: it fell an easy prey, and the Spanish governor, with the troops, retired to the fortress of Barancas, about six miles distant. As its surrender was refused, an attack was made upon it, and, after a bombardment and cannonading for two days, and the loss of several lives, it was surrendered, and the garrison, agreeably to the terms of a capitulation, was transported to the Island of Cuba. The civil government of Spain was forcibly suppressed, the revenue laws abolished, and municipal and financial officers, from the Americans, were, by the authority of the general, appointed to the different ports.

The execution of two Englishmen, Arbuthnot and Ambrister, contrary to all the laws of civilized nations, however atrocious, is more an indication of the character of the commander, than of the nature of a political transaction, and may be passed over without remark. When the conquest of West Florida was thus achieved, Jackson gave orders to his second in command, General Gaines, to attack St Augustine, " to hold the garrison prisoners until he heard from the President of the United States, or transport them to Cuba, as in his judgment, under existing circumstances, he might think best." This completion of the general's designs was, however, frustrated by the prompt and decisive orders given to Gaines, to desist from the attempt. We are not now considering the weakness or the iniquity of the government of America, nor do we find it necessary here to solve the problem, to which of those causes the subsequent exculpation of Jackson is to be attributed. The influence of this conduct on Spain seemed, however, to have been effectual. Without a revenue, or the power of raising one, with a ministry constantly changing with all the caprices of the monarch, with a population governed by priests and monks, with the contempt of all Europe, and with insurrections of a formidable nature in its transatlantic dominions, the ambassador of Spain was reluctantly forced to yield to the insolent injustice of the American Republicans; who, for the sake of gaining the uncultivated provinces of Florida, have apparently renounced their intention of giving either countenance or support to the republicans of the south.

The treaty concluded by Don Luis Onis, on the part of Spain, has not been ratified by the court of Madrid, although the stipulated period for its completion is now past; and the present condition of Florida remains thus: The whole of East Florida is in the possession of Spain; Pensacola has been given back to a Spanish commander; and the country in dispute, between the Iberville and the Perdido, is in the hands of the government of the United States.

Bertram's *Florida*.—Cardena's *Historia de la Florida*.—*Correspondence between Don Luis Onis and the Honourable Mr Secretary Adams*.—Observations made by the Writer of this Article, during a residence of eight months in Florida. (W. W.)

FLUENTS, OR INTEGRALS.

Section I. *Definitions*.—II. *General Theorems*.—III. *Rational Fluxions*.—IV. *Irrational Fluxions*.—V. *Circular Fluxions*.—VI. *Logarithmic Fluxions*.—VII. *Exponential Fluxions*.—VIII. *Index of Fluxions*.

Sect. I.—*Definitions*.

The fluents of such expressions, as are the most likely to occur in the solution of physical problems, may be very conveniently arranged in the form of a Table; the principal materials of which will be extracted from *Meier Hirsch's Integraltafeln*. 4. Berlin, 1810. It might have been somewhat enlarged by additional matter that may be found in the earlier publications of our countrymen *Waring* and *Landen*, which have been particularly consulted on the occasion; but Waring's improvements relate most commonly to cases so complicated, as seldom to be applicable to practical purposes; and Landen's theorems, though incomparably more distinct and better arranged than Waring's, tend rather to the investigation of some elegant analogies, than to the facilitation of actual computations. Some of these, however, will be briefly noticed, and an improvement in the mode of notation will be attempted, which, if universally adopted, would tend to save much unnecessary circumlocution in the enunciation of many general theorems.

1. The earlier letters of the alphabet, as far as q, and sometimes r, are commonly employed to denote constant quantities; the subsequent letters generally for quantities considered as variable. They are here employed as relating indifferently to quantities positive or negative, and to numbers whole or fractional; except when they are used as indices or exponents.

2. The Italic character is employed, in preference to others, for denoting quantities in general, the Roman for characteristic marks, as d for a fluxion, or differential, sin, cos, or f, ç, for sine and cosine; and hl for hyperbolic logarithm. The long Italic $\int$, however, not being otherwise used, serves very conveniently as a characteristic, to denote a fluent.

3. When the Italic letters m, n, p, q, r, or any others, are employed as indices, they are to be here understood as denoting any numbers without limitation; the Roman small letters, m, n, will be applied to whole numbers only, excluding fractions, but either positive or negative, or 0; the small Italic Capitals *M*, *N*, to positive numbers, whether whole or fractional, excluding negative numbers only; and the small Roman Capitals M, N, to positive integers only, including however 0.

4. The characteristic Σ implies the sum of a finite number of terms, derived from all the possible variations of a quantity, which is here denoted by a small letter of the Greek alphabet.

5. A comma, in an index, denotes or.

6. The fluents, indicated by the table, are to be understood as corresponding equally to any particular values of the quantities concerned; so that, in order to obtain the expression of the definite quantity required by the conditions of any problem, we must always take the difference of the two values found by substituting two values of the elementary variable quantities; and this rule being general, it supersedes the necessity of introducing a constant correction of the fluent in each particular case.

7. Particular values of fluents, limited on both sides, are distinguished by accents, $\int'$.

Sect. II.—*General Theorems*.

1. $\int \mathrm{d}x = x$. See Sect. I. Art. 6.

2. $\int a\mathrm{d}x = ax$.

3. $\int x^n \mathrm{d}x = \frac{1}{n+1} x^{n+1}$. Cavalleri was acquainted with the fluent of x^{N}; Wallis extended it to x^{n}; but Newton first discovered, in 1672, the general expression, as comprehending the fluxion of an irrational quantity.

Exception. In the case $n = -1$, the theorem fails, and we must substitute

$$\int \frac{\mathrm{d}x}{x} = \mathrm{hl}\ x$$

4. $\int y\mathrm{d}x = xy - \int x\mathrm{d}y$

5. $\int y\mathrm{d}z = \frac{\mathrm{d}y}{\mathrm{d}x} \int z\mathrm{d}x - \frac{\mathrm{d}^2 y}{\mathrm{d}x.^2} \int^2 z\mathrm{d}x.^2 + \frac{\mathrm{d}^3 y}{\mathrm{d}x.^3} \int^3 z\mathrm{d}x.^3 - \ldots$; $\mathrm{d}x$ being any constant fluxion whatever. This very elegant theorem may be applied with great convenience to all the more complicated logarithmic functions. See n. 547, 556, 570, 572. Taylor, *Meth. Incr.*

6. $\int' \mathrm{d}y = x\frac{\mathrm{d}\textsc{y}}{\mathrm{d}x} + \frac{x^2}{2} \cdot \frac{\mathrm{d}^2 \textsc{y}}{\mathrm{d}x.^2} + \frac{x^3}{2.3} \cdot \frac{\mathrm{d}^3 \textsc{y}}{\mathrm{d}x.^3} + \ldots$: Y being the initial value of y, this theorem gives the increment of y corresponding to any increment of x beginning at the same time: it may be called the master key which opens a way to all the treasures of analysis. From Taylor, *Meth. Incr.*

Sect. III.—*Rational Fluxions*.

A. $x^{\mathrm{m}}(a+bx)^{-\mathrm{N}}\mathrm{d}x$

a. $\frac{x^{\mathrm{M}}\mathrm{d}x}{a+bx}$

Fluents.

7. $\int \frac{x^{M}dx}{a+bx} = \frac{x^{M}}{Mb} - \frac{ax^{M-1}}{(M-1)b^2} + \frac{a^2x^{M-2}}{(M-2)b^3} - \ldots \pm \frac{a^{M-1}x}{b^{M}} \mp \frac{a^{M}}{b^{M+1}} \text{hl}(a+bx)$

Examples.

8. $\int \frac{dx}{a+bx} = \frac{1}{b} \text{hl}(a+bx)$

9. $\int \frac{xdx}{a+bx} = \frac{x}{b} - \frac{a}{b^2} \text{hl}(a+bx)$

10. $\int \frac{x^2dx}{a+bx} = \frac{x^2}{2b} - \frac{ax}{b^2} + \frac{a^2}{b^3} \text{hl}(a+bx)$

11. $\int \frac{x^3dx}{a+bx} = \frac{x^3}{3b} - \frac{ax^2}{2b^2} + \frac{a^2x}{b^3} - \frac{a^3}{b^4} \text{hl}(a+bx)$

b. $\frac{x^{M}dx}{(a+bx)^2}$

12. $\int \frac{dx}{(a+bx)^2} = -\frac{1}{b(a+bx)}$

13. $\int \frac{xdx}{(a+bx)^2} = \frac{a}{b^2(a+bx)} + \frac{1}{b^2} \text{hl}(a+bx)$

14. $\int \frac{x^2dx}{(a+bx)^2} = \left(\frac{x^2}{b} - \frac{2a^2}{b^3}\right)\frac{1}{a+bx} - \frac{2a}{b^3} \text{hl}(a+bx)$

15. $\int \frac{x^3dx}{(a+bx)^2} = \left(\frac{x^3}{2b} - \frac{3ax^2}{2b^2} + \frac{3a^3}{b^4}\right)\frac{1}{a+bx} + \frac{3a^2}{b^4} \text{hl}(a+bx)$

c. $\frac{x^{M}dx}{(a+bx)^3}$

16. $\int \frac{dx}{(a+bx)^3} = -\frac{1}{2b(a+bx)^2}$

17. $\int \frac{xdx}{(a+bx)^3} = -\left(\frac{x}{b} + \frac{a}{2b^2}\right)\frac{1}{(x+bx)^2}$

18. $\int \frac{x^2dx}{(a+bx)^3} = \left(\frac{2ax}{b^2} + \frac{3a^2}{2b^3}\right)\frac{1}{(a+bx)^2} + \frac{1}{b^3} \text{hl}(a+bx)$

19. $\int \frac{x^3dx}{(a+bx)^3} = \left(\frac{x^3}{b} - \frac{6a^2x}{b^3} - \frac{9a^3}{2b^4}\right)\frac{1}{(a+bx)^2} - \frac{3a}{b^4} \text{hl}(a+bx)$

d. $\frac{dx}{x^{M}(a+bx)}$

20. $\int \frac{dx}{x^{M}(a+bx)} = -\frac{1}{(M-1)ax^{M-1}} + \frac{b}{(M-2)a^2x^{M-2}} - \frac{b^2}{(M-3)a^3x^{M-3}} + \ldots \frac{b^{M-1}}{a^{M}} \text{hl}\frac{a+bx}{x}$

Examples.

21. $\int \frac{dx}{x(a+bx)} = -\frac{1}{a} \text{hl}\frac{a+bx}{x}$

22. $\int \frac{dx}{x^2(a+bx)} = -\frac{1}{ax} + \frac{b}{x^2} \text{hl}\frac{a+bx}{x}$

23. $\int \frac{dx}{x^3(a+bx)} = -\frac{1}{2ax^2} + \frac{b}{a^2x} - \frac{b^2}{a^3} \text{hl}\frac{a+bx}{x}$

e. $\frac{dx}{x^{M}(a+bx^2}$

24. $\int \frac{dx}{x(a+bx)^2} = \frac{1}{a(a+bx)} - \frac{1}{a^2} \text{hl}\frac{a+bx}{x}$

25. $\int \frac{dx}{x^2(a+bx)^2} = \left(-\frac{1}{ax} - \frac{2b}{a^2}\right)\frac{1}{a+bx} + \frac{2b}{a^3} \text{hl}\frac{a+bx}{x}$

26. $\int \frac{dx}{x^3(a+bx)^2} = \left(-\frac{1}{2ax^2} + \frac{3b}{2a^2x} + \frac{3b^2}{a^3}\right)\frac{1}{a+bx} - \frac{3b^2}{a^4} \text{hl}\frac{a+bx}{x}$

f. $\frac{dx}{x^{M}(a+bx)^3}$

27. $\int \frac{dx}{x(a+bx)^3} = \left(\frac{3}{2a} + \frac{bx}{a^2}\right)\frac{1}{(a+bx)^2} - \frac{1}{a^3} \text{hl}\frac{a+bx}{x}$

28. $\int \frac{dx}{x^2(a+bx)^3} = \left(-\frac{1}{ax} - \frac{9b}{2a^2} - \frac{3b^2x}{a^3}\right)\frac{1}{(a+bx)^2} + \frac{3b}{a^4} \text{hl}\frac{a+bx}{x}$

29. $\int \frac{dx}{x^3(a+bx)^3} = \left(-\frac{1}{2ax^2} + \frac{2b}{a^2x} + \frac{9b^2}{a^3} + \frac{6b^3x}{a^4}\right)\frac{1}{(a+bx)^2} - \frac{6b^2}{a^5} \text{hl}\frac{a+bx}{x}$

B. $x^{m}(a+bx^2)^{-N}dx$

a. $\frac{x^{M}dx}{a+bx^2}$

30. $\int \frac{dx}{a+bx^2} + \sqrt{\frac{1}{ab}} \text{arc tang } x\sqrt{\frac{b}{a}} = \frac{1}{2\sqrt{(ab)}} \text{hl}\frac{\sqrt{a}+x\sqrt{-b}}{\sqrt{a}-x\sqrt{-b}}$

31. $\int \frac{xdx}{a+bx^2} = \frac{1}{2b} \text{hl}(a+bx^2)$

32. $\int \frac{x^2dx}{a+bx^2} = \frac{x}{b} - \frac{a}{b}\int\frac{dx}{a+bx^2}$

33. $\int \frac{x^3dx}{a+bx^2} = \frac{x^2}{2b} - \frac{a}{2b^2} \text{hl}(a+bx^2)$

b. $\frac{x^{M}dx}{(a+bx^2)^2}$

34. $\int \frac{dx}{(a+bx^2)^2} = \frac{x}{2a(a+bx^2)} + \frac{1}{2a}\int\frac{dx}{a+bx^2}$

35. $\int \frac{xdx}{(a+bx^2)^2} = -\frac{1}{2b(a+bx^2)}$

36. $\int \frac{x^2\,dx}{(a+bx^2)^2} = -\frac{x}{2b(a+bx^2)} + \frac{1}{2b}\int\frac{dx}{a+bx^2}$

37. $\int \frac{x^3\,dx}{(a+bx^2)^2} = \frac{a}{2b^2(a+bx^2)} + \frac{1}{2b^2}\,\mathrm{hl}\,(a+bx^2)$

c. $\frac{x^M\,dx}{(a+bx^2)^3}$

38. $\int\frac{dx}{(a+bx^2)^3} = \left(\frac{3bx^3}{8a^2}+\frac{5x}{8a}\right)\frac{1}{(a+bx^2)^2} + \frac{3}{8a^2}\int\frac{dx}{a+bx^2}$

39. $\int\frac{x\,dx}{(a+bx^2)^3} = -\frac{1}{4b(a+bx^2)^2}$

40. $\int\frac{x^2\,dx}{(a+bx^2)^3} = \left(\frac{x^3}{8a}-\frac{x}{8b}\right)\frac{1}{(a+bx^2)^2} + \frac{1}{8ab}\int\frac{dx}{a+bx^2}$

41. $\int\frac{x^3\,dx}{(a+bx^2)^3} = \left(-\frac{x^2}{2b}-\frac{a}{4b^2}\right)\frac{1}{(a+bx^2)^2}$

d. $\frac{dx}{x^M(a+bx^2)}$

42. $\int\frac{dx}{x(a+bx^2)} = \frac{1}{2a}\,\mathrm{hl}\,\frac{x^2}{a+bx^2}$

43. $\int\frac{dx}{x^2(a+bx^2)} = -\frac{1}{ax}-\frac{b}{a}\int\frac{dx}{a+bx^2}$

44. $\int\frac{dx}{x^3(a+bx^2)} = -\frac{1}{2ax^2}-\frac{b}{2a^2}\,\mathrm{hl}\,\frac{x^2}{a+bx^2}$

e. $\frac{dx}{x^M(a+bx^2)^2}$

45. $\int\frac{dx}{x(a+bx^2)^2} = \frac{1}{2a(a+bx^2)}+\frac{1}{2a^2}\,hl\,\frac{x^2}{a+bx^2}$

46. $\int\frac{dx}{x^2(a+bx^2)^2} = \left(-\frac{1}{ax}-\frac{3bx}{2a^2}\right)\frac{1}{a+bx^2} - \frac{3b}{2a^2}\int\frac{dx}{a+bx^2}$

47. $\int\frac{dx}{x^3(a+bx^2)^2} = \left(-\frac{1}{2ax^2}-\frac{b}{a^2}\right)\frac{1}{a+bx^2} - \frac{b}{a^3}\,\mathrm{hl}\,\frac{x^2}{a+bx^2}$

f. $\frac{dx}{x^M(a+bx^2)^3}$

48. $\int\frac{dx}{x(a+bx^2)^3} = \left(\frac{3}{4a}+\frac{bx^2}{2a^2}\right)\frac{1}{(a+bx^2)^2} + \frac{1}{2a^3}\,\mathrm{hl}\,\frac{x^2}{a+bx^2}$

49. $\int\frac{dx}{x^2(a+bx^2)^3} = \left(-\frac{1}{ax}-\frac{25bx}{8a^2}-\frac{15b^2x^3}{8a^3}\right)\frac{1}{(a+bx^2)^2} - \frac{15b}{8a^3}\int\frac{dx}{a+bx^2}$

50. $\int\frac{dx}{x^3(a+bx^2)^3} = \left(-\frac{1}{2ax^2}-\frac{9b}{4a^2}-\frac{3b^2x^2}{2a^3}\right)\frac{1}{(a+bx^2)^2} - \frac{3b}{2a^4}\,\mathrm{hl}\,\frac{x^2}{a+bx^2}$

C. $x^m(a+bx+cx^2)^{-N}dx$

Put $a+bx+cx^2=y$, $4ac-b^2=k$.

a. $\frac{x^M\,dx}{a+bx+cx^2} = \frac{x^M\,dx}{y}$

51. $\int\frac{dx}{a+bx+cx^2} = \frac{2}{\sqrt{k}}\,\text{arc tang}\,\frac{2cx+b}{\sqrt{k}} = \frac{1}{\sqrt{-k}}\,\mathrm{hl}\,\frac{2cx+b-\sqrt{-k}}{2cx+b+\sqrt{-k}}$

52. $\int\frac{x\,dx}{a+bx+cx^2}=\frac{1}{2c}\,\mathrm{hl}\,y-\frac{b}{2c}\int\frac{dx}{y}$

53. $\int\frac{x^2\,dx}{a+bx+cx^2} = \frac{x}{c}-\frac{b}{2c^2}\,\mathrm{hl}\,y+\left(\frac{b^2}{2c^2}-\frac{a}{c}\right)\int\frac{dx}{y}$

54. $\int\frac{x^3\,dx}{a+bx+cx^2}=\frac{x^2}{2c}-\frac{bx}{c^2}+\left(\frac{b^2}{2c^3}-\frac{a}{2c^2}\right)\mathrm{hl}\,y - \left(\frac{b^3}{2c^3}-\frac{3ab}{2c^2}\right)\int\frac{dx}{y}$

b. $\frac{x^M\,dx}{(a+bx+cx^2)^2}=\frac{x^M\,dx}{y^2}$

55. $\int\frac{dx}{(a+bx+cx^2)^2} = \frac{2cx+b}{ky}+\frac{2c}{k}\int\frac{dx}{y}$

56. $\int\frac{x\,dx}{(a+bx+cx^2)^2} = -\frac{1}{2cy}-\frac{b}{2c}\int\frac{dx}{y^2}$

57. $\int\frac{x^2\,dx}{(a+bx+cx^2)^2} = -\frac{x}{cy}+\frac{a}{c}\int\frac{dx}{y^2}$

58. $\int\frac{x^3\,dx}{(a+bx+cx^2)^2} = \left(\frac{bx}{c^2}+\frac{b}{2c^2}\right)\frac{1}{y}+\frac{1}{2c^2}\,\mathrm{hl}\,y - \frac{ab}{2c^2}\int\frac{dx}{y^2}-\frac{b}{2c^2}\int\frac{dx}{y}$

c. $\frac{x^M\,dx}{(a+bx+cx^2)^3}=\frac{x^M\,dx}{y^3}$

59. $\int\frac{dx}{(a+bx+cx^2)^3} = \left(\frac{1}{2ky^2}+\frac{3c}{k^2y}\right)(2cx+b)+\frac{6c^2}{k^2}\int\frac{dx}{y}$

60. $\int\frac{x\,dx}{(a+bx+cx^2)^3} = -\frac{1}{4cy^2}-\frac{b}{2c}\int\frac{dx}{y^3}$

61. $\int\frac{x^2\,dx}{(a+bx+cx^2)^3} = \left(-\frac{x}{3c}+\frac{b}{12c^2}\right)\frac{1}{y^2}+\left(\frac{b^2}{6c^2}+\frac{a}{3c}\right)\int\frac{dx}{y^3}$

62. $\int\frac{x^3\,dx}{(a+bx+cx^2)^3} = \left(-\frac{x^2}{2c}-\frac{a}{4c^2}\right)\frac{1}{y^2}-\frac{ab}{2c^2}\int\frac{dx}{y^3}$

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d. $\frac{dx}{x^M(a+bx+cx^2)} = \frac{dx}{x^M y}$

63. $\int \frac{dx}{x(a+bx+cx^2)} = \frac{1}{2a}\,\mathrm{hl}\,\frac{x^2}{y} - \frac{b}{2a}\int\frac{dx}{y}$

64. $\int \frac{dx}{x^2(a+bx+cx^2)} = \frac{1}{ax} - \frac{b}{2a^2}\,\mathrm{hl}\,\frac{x^2}{y} + \left(\frac{b^2}{2a^2} - \frac{c}{a}\right)\int\frac{dx}{y}$

65. $\int \frac{dx}{x^3(a+bx+cx^2)} = -\frac{1}{2ax^2} + \frac{b}{a^2x} + \left(\frac{b^2}{2a^3} - \frac{c}{2a^2}\right)\mathrm{hl}\,\frac{x^2}{y} - \left(\frac{b^3}{2a^3} - \frac{3bc}{2a^2}\right)\int\frac{dx}{y}$

e. $\frac{dx}{x^M(a+bx+cx^2)^2} = \frac{dx}{x^M y^2}$

66. $\int \frac{dx}{x(a+bx+cx^2)^2} = \frac{1}{2ay} + \frac{1}{2a^2}\,\mathrm{hl}\,\frac{x^2}{y} - \frac{b}{2a}\int\frac{dx}{y^2} - \frac{b}{2a^2}\int\frac{dx}{y}$

67. $\int \frac{dx}{x^2(a+bx+cx^2)^2} = \left(-\frac{1}{ax} - \frac{b}{a^2}\right)\frac{1}{y} - \frac{b}{a^3}\,\mathrm{hl}\,\frac{x^2}{y} + \left(\frac{b^2}{a^2} - \frac{3c}{a}\right)\int\frac{dx}{y^2} + \frac{b^2}{a^3}\int\frac{dx}{y}$

68. $\int \frac{dx}{x^3(a+bx+cx^2)^2} = \left(-\frac{1}{2ax^2} + \frac{3b}{2a^2x} + \frac{3b^2}{2a^3} - \frac{c}{a^2}\right)\frac{1}{y} + \left(\frac{3b^2}{2a^4} - \frac{c}{a^3}\right)\mathrm{hl}\,\frac{x^2}{y} - \left(\frac{3b^3}{2a^3} - \frac{11bc}{2a^2}\right)\int\frac{dx}{y^2} - \left(\frac{3b^3}{2a^4} - \frac{bc}{a^3}\right)\int\frac{dx}{y}$

f. $\frac{dx}{x^M(a+bx+cx^2)^3} = \frac{dx}{x^M y^3}$

69. $\int \frac{dx}{x(a+bx+cx^2)^3} = \frac{1}{4ay^2} + \frac{1}{2a^2y} + \frac{1}{2a^3}\,\mathrm{hl}\,\frac{x^2}{y} - \frac{b}{2a}\int\frac{dx}{y^3} - \frac{b}{2a^2}\int\frac{dx}{y^2} - \frac{b}{2a^3}\int\frac{dx}{y}$

70. $\int \frac{dx}{x^2(a+bx+cx^2)^3} = -\frac{1}{axy^2} - \frac{3b}{a}\int\frac{dx}{xy^3} - \frac{5c}{a}\int\frac{dx}{y^3}$

71. $\int \frac{dx}{x^3(a+bx+cx^2)^3} = \left(-\frac{1}{2ax^2} + \frac{2b}{a^2x}\right)\frac{1}{y^2} + \left(\frac{6b^2}{a^2} - \frac{3c}{a}\right)\int\frac{dx}{xy^3} + \frac{10bc}{a^2}\int\frac{dx}{y^3}$

D. $x^m(a+bx^3)^{-N}dx$

a. $\frac{x^M dx}{x+bx^3}$

Put $\frac{a}{b} = k^3$.

72. $\int\frac{dx}{a+bx^3} = \frac{1}{3bk^2}\left(\frac{1}{2}\,\mathrm{hl}\,\frac{(x+k)^2}{x^2-kx+k^2} + \sqrt{3}.\ \text{arc tang}\,\frac{\sqrt{3}.\,x}{2k-x}\right)$

73. $\int\frac{xdx}{a+bx^3} = \frac{-1}{3bk}\left(\frac{1}{2}\,\mathrm{hl}\,\frac{(x+k)^2}{x^2-kx+k^2} - \sqrt{3}.\ \text{arc tang}\,\frac{\sqrt{3}.x}{2k-2}\right)$

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74. $\int\frac{x^2dx}{a+bx^3} = \frac{1}{3b}\,hl\,(a+bx^3)$

75. $\int\frac{x^3dx}{a+bx^3} = \frac{x}{b} - \frac{a}{b}\int\frac{dx}{a+bx^3}$

b. $\frac{x^M dx}{(a+bx^3)^2}$

76. $\int\frac{dx}{(a+bx^3)^2} = \frac{x}{3a(a+bx^3)} + \frac{2}{3a}\int\frac{dx}{a+bx^3}$

77. $\int\frac{xdx}{(a+bx^3)^2} = \frac{x^2}{3a(a+bx^3)} + \frac{1}{3a}\int\frac{xdx}{a+bx^3}$

78. $\int\frac{x^2dx}{(a+bx^3)^2} = -\frac{1}{3b(a+bx^3)}$

79. $\int\frac{x^3dx}{(a+bx^3)^2} = -\frac{x}{3b(a+bx^3)} + \frac{1}{3b}\int\frac{dx}{x+bx^3}$

c. $\frac{x^M dx}{(a+bx^3)^3}$

80. $\int\frac{dx}{(a+bx^3)^3} = \left(\frac{5bx^4}{18a^2} + \frac{4x}{9a}\right)\frac{1}{(x+bx^3)^2} + \frac{5}{9a^2}\int\frac{dx}{a+bx^3}$

81. $\int\frac{xdx}{(a+bx^3)^3} = \left(\frac{2bx^5}{9a^2} + \frac{7x^2}{18a}\right)\frac{1}{(a+bx^3)^2} + \frac{2}{9a^2}\int\frac{xdx}{a+bx^3}$

82. $\int\frac{x^2dx}{(a+bx^3)^3} = -\frac{1}{6b(a+bx^3)^2}$

83. $\int\frac{x^3dx}{(a+bx^3)^3} = \left(\frac{x^4}{18a} - \frac{x}{9b}\right)\frac{1}{(a+bx^3)^2} + \frac{1}{9ab}\int\frac{dx}{a+bx^3}$

d. $\frac{dx}{x^M(a+bx^3)}$

84. $\int\frac{dx}{x(a+bx^3)} = \frac{1}{3a}\,\mathrm{hl}\,\frac{x^3}{a+bx^3}$

85. $\int\frac{dx}{x^2(a+bx^3)} = -\frac{1}{ax} - \frac{b}{a}\int\frac{xdx}{a+bx^3}$

86. $\int\frac{dx}{x^3(a+bx^3)} = -\frac{1}{2ax^2} - \frac{b}{a}\int\frac{dx}{x+bx^3}$

e. $\frac{dx}{x^M(a+bx^3)^2}$

87. $\int\frac{dx}{x(a+bx^3)^2} = \frac{1}{3a(a+bx^3} - \frac{1}{3a^2}\,\mathrm{hl}\,\frac{a+bx^3}{x^3}$

88. $\int\frac{dx}{x^2(a+bx^3)^2}=\left(-\frac{1}{ax}-\frac{4bx^2}{3a^2}\right)\frac{1}{a+bx^3}-\frac{4b}{3a^2}\int\frac{xdx}{a+bx^3}$

89. $\int\frac{dx}{x^3(a+bx^3)^2}=\left(-\frac{1}{2ax^2}-\frac{5bx}{ba^2}\right)\frac{1}{a+bx^3}-\frac{5b}{3a^2}\int\frac{dx}{a+bx^3}$

E. $x^{N-M}(a+bx^N)^{-1}dx$

a. $N=2P+1$, an odd number; putting $k^N=\frac{a}{b}$,

$\theta=\frac{180^\circ}{N},\frac{540^\circ}{N},\frac{900^\circ}{N}\ldots\frac{(N-2)180^\circ}{N}$, P values.

90. $\int\frac{x^{2P+1-M}dx}{a+bx^{2P+1}}=\frac{1}{Nb(-k)^{M-1}}\,\text{hl}\,(x+k)+\frac{1}{Nbk^{M-1}}$

$\Sigma\left(\cos(M-1)\theta\,\text{hl}\,(x^2-2kx\cos\theta+k^2)+2\,\text{sim}\,(M-1)\theta\,\text{arc tang}\frac{x\sin\theta}{k-x\cos\theta}\right)$; the characteristic Σ implying the sum of the P values depending on those of θ. From Cotes's discoveries.

91. $\int\frac{x^{2P-M}dx}{x+bx^{2P}}$; 1, when $\frac{a}{b}$ is negative, putting $k^N=-\frac{a}{b}$; $=\frac{1}{Nbk^{M-1}}\,\text{hl}\,(x-k)+\frac{1}{Nb(-k)^{M-1}}\,\text{hl}\,(x+k)+\frac{1}{Nbk^{M-1}}\,\Sigma\left(\cos(M-1)\theta\,\text{hl}\,(x^2-2kx\cos\theta+k^2)+2\sin(M-1)\theta\,\text{arc tang}\frac{x\sin\theta}{k-x\cos\theta}\right)$; Σ relating to the $P-1$ values of θ, $\frac{360^\circ}{N},\frac{720^\circ}{N},\frac{1080^\circ}{N},\ldots\frac{(N-2)180^\circ}{N}$; 2, when $\frac{a}{b}$ is positive, putting $k^N=\frac{a}{b}$; $=\frac{1}{Nbk^{M-1}}$

$\Sigma\left(\cos(M-1)\theta\,\text{hl}\,(x^2-2kx\cos\theta+k^2)+2\sin(M-1)\theta\,\text{arc tang}\frac{x\sin\theta}{k-x\cos\theta}\right)$; Σ relating to the P values of θ, $\frac{180^\circ}{N},\frac{540^\circ}{N},\frac{900^\circ}{N},\ldots$

F. $x^{2N-M}(a+bx^N+cx^{2N})^{-1}dx$

92. $\int\frac{x^{2N-M}dx}{a+bx^N+cx^{2N}}$; first, $4ac$ being $>b^2$, and putting $\cos\varkappa=-\frac{b}{2\sqrt{(ac)}}$ and $\theta=\frac{\varkappa}{N}$, $\frac{360^\circ+\varkappa}{N},\ldots\frac{(N-1)360^\circ+\varkappa}{N}$; $=\frac{\text{cosec}\,\varkappa}{2Nck^{M-1}}$

$\Sigma\left(-\sin(M-N-1)\theta\,\text{hl}\,(x^2-2kx\cos\theta+k^2)+2\cos(M-N-1)\theta\,\text{arc tang}\frac{x\sin\theta}{k-x\cos\theta}\right)$; secondly, $4ac$ being $<b^2$, and putting $\sqrt{(b^2-4ac)}=h$, $\frac{b-h}{2}=f$, and $\frac{b+h}{2}=g$,

$$\int\frac{x^Mdx}{a+bx^N+cx^{2N}}=\frac{c}{h}\left(\int\frac{x^Mdx}{cx^N+f}-\int\frac{x^Mdx}{cx^N+g}\right)$$

G. $x^M(x+f)^{-1}(x+g)^{-1}\ldots(x^2+ax+b)^{-1}\ldots dx$

93. $\int\frac{dx}{(x+f)(x+g)}=\frac{1}{g-f}\,\text{hl}\frac{x+f}{x+g}$

94. $\int\frac{xdx}{(x+f)(x+g)}=\frac{1}{g-f}(g\,\text{hl}\,(x+g)-f\,\text{hl}\,[x+f])$

95. $\int\frac{dx}{(x+f)(x+g)(x+h)}=\frac{1}{(g-f)(h-f)}\,\text{hl}\,(x+f)+\frac{1}{(f-g)(h-g)}\,\text{hl}\,(x+g)+\frac{1}{(f-h)(g-h)}\,\text{hl}\,(x+h)$

96. $\int\frac{dx}{(x+f)(x^2+a)}=\frac{1}{f^2+a}\left(\text{hl}\,\frac{x+f}{\sqrt{(x^2+a)}}+f\int\frac{dx}{x^2+a}\right)$

97. $\int\frac{dx}{(x^2+a)(x^2+b)}=\frac{1}{b-a}\left(\int\frac{dx}{x^2+a}-\int\frac{dx}{x^2+b}\right)$

98. $\int\frac{dx}{(x+f)(x^2+ax+b)}=\frac{1}{f^2-af+b}\left(\frac{1}{2}\,\text{hl}\,\frac{x+f^2}{x^2+ax+b}+f-\frac{1}{2}a\right)\int\frac{dx}{x^2+ax+b}$

H. $x^m(A+Bx+Cx^2\ldots)(a+bx+cx^2\ldots)^{-1}dx$

99. $\int\frac{A+Bx+Cx^2\ldots}{a+bx+cx^2\ldots}dx=\Sigma\,\text{hl}\,(x-\varrho)\frac{\upsilon}{\zeta}$; ϱ being successively each of the roots of the equation $a+bx+cx^2\ldots=0$, $\upsilon=A+B\varrho+C\varrho^2\ldots$, and $\zeta=b+2c\varrho+3d\varrho^2\ldots$; provided, however, that the denominator contain higher powers of x than the numerator, and that all the values of ϱ be different; a limitation first laid down by Newton.

100. $\int\frac{A+Bx+Cx^2\ldots}{a+bx+cx^2\ldots}x^Mdx=\Sigma\int\frac{x^Mdx}{x-\varrho}\cdot\frac{\upsilon}{\zeta}$

101. $\int\frac{A+Bx+Cx^2\ldots}{a+bx+cx^2\ldots}\cdot\frac{dx}{x^M}=\Sigma\int\frac{dx}{x^M(x\varrho)}\,\frac{\upsilon}{\zeta}$

SECT. IV.—*Irrational Fluxions.*

A. $x^{m}(a+bx)^{\frac{n}{2}}dx$

a. $\dfrac{x^{M}dx}{\sqrt{(a+bx)}}=\dfrac{x^{M}dx}{\sqrt{y}}$

102. $\displaystyle\int\frac{dx}{\sqrt{(a+bx)}}=\frac{2}{b}\sqrt{(a+bx)}=\frac{2}{b}\sqrt{y}$

103. $\displaystyle\int\frac{xdx}{\sqrt{(a+bx)}}=\left(\frac{1}{3}y-a\right)\frac{2\sqrt{y}}{b2}$

104. $\displaystyle\int\frac{x^2dx}{\sqrt{(a+bx)}}=\left(\frac{1}{5}y^2-\frac{2}{3}ay+y^2\right)\frac{2\sqrt{y}}{b^3}$

105. $\displaystyle\int\frac{x^3dx}{\sqrt{(a+bx)}}=\left(\frac{1}{7}y^3-\frac{3}{5}ay^2+a^2y-a^3\right)\frac{2\sqrt{y}}{b^4}$

b. $\dfrac{dx}{x^{M}\sqrt{(a+bx)}}=\dfrac{dx}{x^{M}\sqrt{y}}$

106. $\displaystyle\int\frac{dx}{x\sqrt{(a+bx)}}=\frac{1}{\sqrt{a}}\,\mathrm{hl}\,\frac{\sqrt{y}-\sqrt{a}}{\sqrt{y}+\sqrt{a}}=\frac{2}{\sqrt{-a}}$ arc tang $\dfrac{\sqrt{y}}{\sqrt{-a}}$. The ambiguity of the roots being decided by the conditions of the problem.

107. $\displaystyle\int\frac{dx}{x^2\sqrt{(a+bx)}}=-\frac{\sqrt{y}}{ax}-\frac{b}{2a}\int\frac{dx}{x\sqrt{y}}$

108. $\displaystyle\int\frac{dx}{x^3\sqrt{(a+bx)}}=\left(-\frac{1}{2ax^2}+\frac{3b}{4a^2x}\right)\sqrt{y}+\frac{3b^2}{8a^2}\int\frac{dx}{x\sqrt{y}}$

c. $\dfrac{x^{M}dx}{(a+bx)^{\frac{3}{2}}}=\dfrac{x^{M}dx}{y^{\frac{3}{2}}}$

109. $\displaystyle\int\frac{dx}{(a+bx)^{\frac{3}{2}}}=-\frac{2}{b\sqrt{(a+bx)}}=-\frac{2}{b\sqrt{y}}$

110. $\displaystyle\int\frac{xdx}{(a+bx)^{\frac{3}{2}}}=(y+a)\frac{2}{b^2\sqrt{y}}$

111. $\displaystyle\int\frac{x^2dx}{(a+bx)^{\frac{3}{2}}}=(\tfrac{1}{3}y^2-2ay-a^2)\frac{2}{b^3\sqrt{y}}$

112. $\displaystyle\int\frac{x^3dx}{(a+bx)^{\frac{3}{2}}}=(\tfrac{1}{3}y^3-ay^2+3a^2y+a^3)\frac{2}{b^3\sqrt{y}}$

d. $\dfrac{dx}{x^{M}(a+bx)^{\frac{3}{2}}}=\dfrac{dx}{x^{M}y^{\frac{3}{2}}}$

113. $\displaystyle\int\frac{dx}{x(a+bx)^{\frac{3}{2}}}=\frac{2}{a\sqrt{y}}+\frac{1}{a}\int\frac{dx}{x\sqrt{y}}$

114. $\displaystyle\int\frac{dx}{x^2(a+bx)^{\frac{3}{2}}}=\left(-\frac{1}{ax}-\frac{3b}{a^2}\right)\frac{1}{\sqrt{y}}-\frac{3b}{2a^2}\int\frac{dx}{x\sqrt{y}}$

115. $\displaystyle\int\frac{dx}{x^3(a+bx)^{\frac{3}{2}}}=\left(-\frac{1}{2ax^2}+\frac{5b}{4a^2x}+\frac{15b^2}{4a^3}\right)\frac{1}{\sqrt{y}}+\frac{15b^2}{8a^3}\int\frac{dx}{x\sqrt{y}}$

e. $\dfrac{x^{M}dx}{(a+bx)^{\frac{5}{2}}}$

116. $\displaystyle\int\frac{dx}{(a+bx)^{\frac{5}{2}}}=-\frac{2}{3by\sqrt{y}}$

117. $\displaystyle\int\frac{xdx}{(a+bx)^{\frac{5}{2}}}=\left(-y+\frac{1}{3}a\right)\frac{2}{b^2y\sqrt{y}}$

118. $\displaystyle\int\frac{x^2dx}{(a+bx)^{\frac{5}{2}}}=\left(y^2+2ay-\frac{1}{3}a^2\right)\frac{2}{b^3y\sqrt{y}}$

119. $\displaystyle\int\frac{x^3dx}{(a+bx)^{\frac{5}{2}}}=\left(\frac{1}{3}y^3-3ay^2-3a^2y+\frac{1}{3}a^3\right)\frac{2}{b^4y\sqrt{y}}$

f. $\dfrac{dx}{x^{M}(a+bx)^{\frac{5}{2}}}$

120. $\displaystyle\int\frac{dx}{x(a+bx)^{\frac{5}{2}}}=\left(\frac{8}{3a}+\frac{2bx}{a^2}\right)\frac{1}{y\sqrt{y}}+\frac{1}{a^2}\int\frac{dx}{x\sqrt{y}}$

121. $\displaystyle\int\frac{dx}{x^2(a+bx)^{\frac{5}{2}}}=\left(-\frac{1}{ax}-\frac{20b}{3a^2}-\frac{5b^2x}{a^3}\right)\frac{1}{y\sqrt{y}}-\frac{5b}{2a^3}\int\frac{dx}{x\sqrt{y}}$

122. $\displaystyle\int\frac{dx}{x^3(a+bx)^{\frac{5}{2}}}=\left(-\frac{1}{2ax^2}+\frac{7b}{4a^2x}+\frac{35b^2}{3a^3}+\frac{35b^3x}{4a^4}\right)\frac{1}{y\sqrt{y}}+\frac{35b^2}{8a^4}\int\frac{dx}{x\sqrt{y}}$

g. $x^{M}\sqrt{(a+bx)}dx=x^{M}\sqrt{y}dx$

123. $\displaystyle\int\sqrt{(a+bx)}dx=\frac{2y\sqrt{y}}{3b}$

124. $\displaystyle\int x\sqrt{(a+bx)}dx=\left(\frac{1}{5}y-\frac{1}{3}a\right)\frac{2y\sqrt{y}}{b^2}$

125. $\displaystyle\int x^2\sqrt{(a+bx)}dx=\left(\frac{1}{7}y^2-\frac{2}{5}ay+\frac{1}{3}a^2\right)\frac{2y\sqrt{y}}{b^3}$

126. $\displaystyle\int x^3\sqrt{(a+bx)}dx=\left(\frac{1}{9}y^3-\frac{3}{7}ay^2+\frac{3}{5}a^2y-\frac{1}{3}a^3\right)\frac{2y\sqrt{y}}{b^4}$

h. $x^{-M}\sqrt{(a+bx)}dx=x^{-M}\sqrt{y}dx$

127. $\displaystyle\int\frac{\sqrt{(a+bx)}dx}{x}=2\sqrt{y}+a\int\frac{dx}{x\sqrt{y}}$

128. $\displaystyle\int\frac{\sqrt{(a+bx)}dx}{x^2}=-\frac{\sqrt{y}}{x}+\frac{b}{2}\int\frac{dx}{x\sqrt{y}}$

129. $\displaystyle\int\frac{\sqrt{(a+bx)}dx}{x^3}=\frac{-y\sqrt{y}}{2ax^2}+\frac{b\sqrt{y}}{4ax}-\frac{b^2}{8a}\int\frac{dx}{x\sqrt{y}}$

i. $x^{M}(a+bx)^{\frac{3}{2}}dx=x^{M}y^{\frac{3}{2}}dx$

130. $\displaystyle\int(a+bx)^{\frac{3}{2}}dx=\frac{2y^2\sqrt{y}}{5b}$

131. $\displaystyle\int x(a+bx)^{\frac{3}{2}}dx=\left(\frac{1}{7}y-\frac{1}{5}a\right)\frac{2y^2\sqrt{y}}{b^2}$

132. $\displaystyle\int x^2(a+bx)^{\frac{3}{2}}dx=\left(\frac{1}{9}y^2-\frac{2}{7}ay+\frac{1}{5}a^2\right)\frac{2y^2\sqrt{y}}{b^3}$

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133. $\int x^3(a+bx)^{\frac{3}{2}}dx=\left(\frac{1}{11}y^3-\frac{1}{3}ay^2+\frac{3}{7}a^2y-\frac{1}{5}a^3\right)\frac{2y^2\surd y}{b^4}$

k. $x^{-M}(a+bx)^{\frac{3}{2}}dx=x^{-M}y^{\frac{3}{2}}dx$

134. $\int\frac{(a+bx)^{\frac{3}{2}}dx}{x}=\left(\frac{1}{3}y+a\right)2\surd y+a^2\int\frac{dx}{x\surd y}$

135. $\int\frac{(a+bx)^{\frac{3}{2}}dx}{x^2}=-\frac{y^2\surd y}{ax}+\frac{3b}{2a}\int\frac{y^{\frac{3}{2}}dx}{x}$

136. $\int\frac{(a+bx)^{\frac{3}{2}}dx}{x^3}=\left(-\frac{1}{2ax^2}-\frac{b}{4a^2x}\right)y^2\surd y+\frac{3b^2}{8a^2}\int\frac{y^{\frac{3}{2}}dx}{x}$

l. $x^M(a+bx)^{\frac{5}{2}}dx=x^My^{\frac{5}{2}}dx$

137. $\int(a+bx)^{\frac{5}{2}}dx=\frac{2y^3\surd y}{7b}$

138. $\int x(a+bx)^{\frac{5}{2}}dx=\left(\frac{1}{9}y-\frac{1}{7}a\right)\frac{2y^3\surd y}{b^2}$

139. $\int x^2(a+bx^{\frac{5}{2}}dx=\left(\frac{1}{11}y^2-\frac{2}{9}ay+\frac{1}{7}a^2\right)\frac{2y^3\surd y}{b^3}$

140. $\int x^3(a+bx)^{\frac{5}{2}}dx=\left(\frac{1}{13}y^3-\frac{3}{11}ay^2+\frac{1}{3}a^2y-\frac{1}{7}a^3\right)\frac{2y^3\surd y}{b^4}$

m. $x^{-M}(a+bx)^{\frac{5}{2}}dx=x^{-M}y^{\frac{5}{2}}dx$

141. $\int\frac{(a+bx)^{\frac{5}{2}}dx}{x}=\left(\frac{1}{5}y^2+\frac{1}{3}ay+a^2\right)2\surd y+a^3\int\frac{dx}{x\surd y}$

142. $\int\frac{(a+bx)^{\frac{5}{2}}dx}{x^2}=-\frac{y^3\surd y}{ax}+\frac{5b}{2a}\int\frac{y^{\frac{5}{2}}dx}{x}$

143. $\int\frac{(a+bx)^{\frac{5}{2}}dx}{x^3}=\left(-\frac{1}{2ax^2}-\frac{3b}{4a^2x}\right)y^3\surd y+\frac{15b^2}{8a^2}\int\frac{y^{\frac{5}{2}}dx}{x}$

C. $x^m(a+bx)^{\frac{n}{3}}dx$

a. $\frac{x^Mdx}{(a+bx)^{\frac{1}{3}}}=x^My^{-\frac{1}{3}}dx$

144. $\int\frac{dx}{(a+bx)^{\frac{1}{3}}}=\frac{3y^{\frac{2}{3}}}{2b}$

145. $\int\frac{xdx}{(a+bx)^{\frac{1}{3}}}=\left(\frac{1}{5}y-\frac{1}{2}a\right)\frac{3y^{\frac{2}{3}}}{b^2}$

146. $\int\frac{x^2dx}{(a+bx)^{\frac{1}{3}}}=\left(\frac{1}{8}y^2-\frac{2}{5}ay+\frac{1}{2}a^2\right)\frac{3y^{\frac{2}{3}}}{b^3}$

147. $\int\frac{x^3dx}{(a+bx)^{\frac{1}{3}}}=\left(\frac{1}{11}y^3-\frac{3}{8}ay^2+\frac{3}{5}a^2y-\frac{1}{2}a^3\right)\frac{3y^{\frac{2}{3}}}{b^4}$

b. $\frac{dx}{x^M(a+bx)^{\frac{1}{3}}}=\frac{dx}{x^My^{\frac{1}{3}}}$

148. $\int\frac{dx}{x(a+bx)^{\frac{1}{3}}}=\frac{1}{a^{\frac{1}{3}}}\left(\frac{3}{2}\,\mathrm{hl}\,\frac{y^{\frac{1}{3}}-a^{\frac{1}{3}}}{x^{\frac{1}{3}}}+\surd 3\text{ arc tang }\frac{\surd 3y^{\frac{1}{3}}}{y^{\frac{1}{3}}+2a^{\frac{1}{3}}}\right)$

149. $\int\frac{dx}{x^2(a+bx)^{\frac{1}{3}}}=-\frac{y^{\frac{2}{3}}}{ax}-\frac{b}{3a}\int\frac{dx}{xy^{\frac{1}{3}}}$

150. $\int\frac{dx}{x^3(a+bx)^{\frac{1}{3}}}=\left(\frac{1}{2ax^2}+\frac{2b}{3a^2x}\right)y^{\frac{2}{3}}+\frac{2b^2}{9a^2}\int\frac{dx}{xy^{\frac{1}{3}}}$

c. $x^M(a+bx)^{-\frac{2}{3}}dx=x^My^{-\frac{2}{3}}dx$

151. $\int\frac{dx}{(a+bx)^{\frac{2}{3}}}=\frac{3y^{\frac{1}{3}}}{b}$

152. $\int\frac{xdx}{(a+bx)^{\frac{2}{3}}}=\left(\frac{1}{4}y-a\right)\frac{3y^{\frac{1}{3}}}{b^2}$

153. $\int\frac{x^2dx}{(a+bx)^{\frac{2}{3}}}=\left(\frac{1}{7}y^2-\frac{1}{2}ay+a^2\right)\frac{3y^{\frac{1}{3}}}{b^3}$

154. $\int\frac{x^3dx}{(a+bx)^{\frac{2}{3}}}=\left(\frac{1}{10}y^3-\frac{3}{7}ay^2+\frac{3}{4}a^2y-a^2\right)\frac{3y^{\frac{1}{3}}}{b^4}$

d. $\frac{dx}{x^M(a+bx)^{\frac{2}{3}}}=\frac{dx}{x^My^{\frac{2}{3}}}$

155. $\int\frac{dx}{x(a+bx)^{\frac{2}{3}}}=\frac{1}{a^{\frac{2}{3}}}\left(\frac{3}{2}\,\mathrm{hl}\,\frac{y^{\frac{1}{3}}-a^{\frac{1}{3}}}{x^{\frac{1}{3}}}\surd 3\text{ arc tang }\frac{\surd 3y^{\frac{1}{3}}}{y^{\frac{1}{3}}+2a^{\frac{1}{3}}}\right)$

156. $\int\frac{dx}{x^2(a+bx)^{\frac{2}{3}}}=-\frac{y^{\frac{1}{3}}}{ax}-\frac{2b}{3a}\int\frac{dx}{xy^{\frac{2}{3}}}$

157. $\int\frac{dx}{x^3(a+bx)^{\frac{2}{3}}}=\left(-\frac{1}{2ax^2}+\frac{5b}{6a^2x}\right)y^{\frac{1}{3}}+\frac{5b^2}{9a^2}\int\frac{dx}{xy^{\frac{2}{3}}}$

e. $x^M(a+bx)^{\frac{1}{3}}dx=x^My^{\frac{1}{3}}dx$

158. $\int(a+bx)^{\frac{1}{3}}dx=\frac{3y^{\frac{4}{3}}}{4b}$

159. $\int x(a+bx)^{\frac{1}{3}}dx=\left(\frac{1}{7}y-\frac{1}{4}a\right)\frac{3y^{\frac{4}{3}}}{b^2}$

160. $\int x^2(a+bx)^{\frac13}dx=\left(\frac{1}{10}y^2-\frac{2}{7}ay+\frac14 a^2\right)\frac{3y^{\frac43}}{b^3}$

161. $\int x^3(a+bx)^{\frac13}dx=\left(\frac1{13}y^3-\frac3{10}ay^2+\frac37a^2y-\frac14a^3\right)\frac{3y^{\frac43}}{b^4}$

f. $x^{-M}(a+bx)^{\frac13}dx=x^{-M}y^{\frac13}dx$

162. $\int\frac{(a+bx)^{\frac13}dx}{x}=3y^{\frac13}+a\int\frac{dx}{xy^{\frac23}}$

163. $\int\frac{(a+bx)^{\frac13}dx}{x^2}=-\frac{y^{\frac43}}{ax}+\frac{b}{3a}\int\frac{y^{\frac13}dx}{x}$

164. $\int\frac{(a+bx)^{\frac13}dx}{x^3}=\left(-\frac1{2ax^2}+\frac{b}{3a^2x}\right)y^{\frac43}-\frac{b^2}{9a^2}\int\frac{y^{\frac13}dx}{x}$

g. $x^M(a+bx)^{\frac23}dx=x^My^{\frac23}dx$

165. $\int(a+bx)^{\frac23}dx=\frac{3y^{\frac53}}{5b}$

166. $\int x(a+bx)^{\frac23}dx=\left(\frac18y-\frac15a\right)\frac{3y^{\frac53}}{b^2}$

167. $\int x^2(a+bx)^{\frac23}dx=\left(\frac1{11}y^2-\frac14ay+\frac15a^2\right)\frac{3y^{\frac53}}{b^3}$

168. $\int x^3(a+bx)^{\frac23}dx=\left(\frac1{14}y^3-\frac3{11}ay^2+\frac38a^2y-\frac15a^3\right)\frac{3y^{\frac53}}{b^4}$

h. $x^{-M}(a+bx)^{\frac23}dx=x^{-M}y^{\frac23}dx$

169. $\int\frac{(a+bx)^{\frac23}dx}{x}=\frac32y^{\frac23}+a\int\frac{dx}{xy^{\frac13}}$

170. $\int\frac{(a+bx)^{\frac23}dx}{x^2}=-\frac{y^{\frac53}}{ax}+\frac{2b}{3a}\int\frac{y^{\frac23}dx}{x}$

171. $\int\frac{(a+bx)^{\frac23}dx}{x^3}=\left(-\frac1{2ax^2}+\frac{b}{6a^2x}\right)y^{\frac53}-\frac{b^2}{9a^2}\int\frac{y^{\frac23}dx}{x}$

D. $x^m(a+bx^2)^{\frac{n}{2}}dx$

a. $x^M(a+bx^2)^{-\frac12}dx=x^My^{-\frac12}dx$

172. $\int\frac{dx}{\sqrt{(a+bx^2)}}=\frac1{\sqrt b}\,\mathrm{hl}\,(x\sqrt b+\sqrt y)=\frac1{\sqrt{-b}}$ arc sin $x\sqrt{\frac{-b}{a}}$; thus $\int\frac{dx}{\sqrt{(1-x^2)}}=$ arc sin x

173. $\int\frac{x\,dx}{\sqrt{(a+bx^2)}}=\frac{\sqrt y}{b}$

$\int\frac{x\,dx}{\sqrt{(1-x^2)}}=-\sqrt y=-$ cos arc sin x

174. $\int\frac{x^2dx}{\sqrt{(a+bx^2)}}=\frac{x\sqrt y}{2b}-\frac{a}{2b}\int\frac{dx}{\sqrt y}$

$\int\frac{x^2dx}{\sqrt{(1-x^2)}}=-\frac12x\sqrt y+\frac12$ arc sin x

175. $\int\frac{x^3dx}{\sqrt{(a+bx^2)}}=\left(\frac{x^2}{3b}-\frac{2a}{3b^2}\right)\sqrt y$

$\int\frac{x^3dx}{\sqrt{(1-x^2)}}=-\left(\frac13x^2+\frac23\right)\sqrt y$

176. $\int\frac{x^4dx}{\sqrt{(a+bx^2)}}=\left(\frac{x^3}{4b}-\frac{3ax}{8b^2}\right)\sqrt y+\frac{3a^2}{8b^2}\int\frac{dx}{\sqrt y}$

$\int\frac{x^4dx}{\sqrt{(1-x^2)}}=-\left(\frac14x^3+\frac38x\right)\sqrt y+\frac38$ arc sin x

b. $\frac{dx}{x^M\sqrt{(a+bx^2)}}=\frac{dx}{x^M\sqrt y}$

177. $\int\frac{dx}{x\sqrt{(a+bx^2)}}=\frac1{2\sqrt a}\,\mathrm{hl}\,\frac{\sqrt y-\sqrt a}{\sqrt y+\sqrt a}=\frac1{\sqrt{-a}}$ arc sec $\left(x\sqrt{-\frac ba}\right)$; thus

$\int\frac{dx}{x\sqrt{(1+x^2)}}$ hl $=\frac{\sqrt y-1}{x}$

$\int\frac{dx}{x\sqrt{(1-x^2)}}=hl\,\frac{\sqrt y-1}{x}=\mathrm{hl}\,\frac{1-\sqrt y}{x}$

$\int\frac{dx}{x\sqrt{(x^2-1)}}=$ arc sec x

178. $\int\frac{dx}{x^2\sqrt{(a+bx^2)}}=-\frac{\sqrt y}{ax}$

179. $\int\frac{dx}{x^3\sqrt{(a+bx^2)}}=-\frac{\sqrt y}{2ax^2}-\frac{b}{2a}\int\frac{dx}{x\sqrt y}$

180. $\int\frac{dx}{x^4\sqrt{(x+bx^2)}}=\left(-\frac1{3ax^2}+\frac{2b}{3a^2x}\right)\sqrt y$

Remark. In some of these cases, the signs of the roots, being ambiguous, require to be determined by the conditions of the problem; but we must adhere to the same root in the same solution.

c. $x^M(a+bx^2)^{-\frac32}dx=x^My^{-\frac32}dx$

181. $\int\frac{dx}{(a+bx^2)^{\frac32}}=\frac{x}{a\sqrt y}$

182. $\int\frac{x\,dx}{(a+bx^2)^{\frac32}}=-\frac1{b\sqrt y}$

183. $\int\frac{x^2dx}{(a+bx^2)^{\frac32}}=-\frac{x}{b\sqrt y}+\frac1b\int\frac{dx}{\sqrt y}$

184. $\int\frac{x^3dx}{(a+bx^2)^{\frac32}}=\left(\frac{x^2}{b}+\frac{2a}{b^2}\right)\frac1{\sqrt y}$

d. $\frac{dx}{x^M(a+bx^2)^{\frac32}}=\frac{dx}{x^My^{\frac32}}$

185. $\int\frac{dx}{x(a+bx^2)}={}^{\frac32}\frac{1}{a\sqrt y}+\frac1a\int\frac{dx}{x\sqrt y}$ (177.)

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186. $\int \frac{dx}{x^2(a+bx^2)^{\frac{3}{2}}} = \left(-\frac{1}{ax}-\frac{2bx}{a^2}\right)\frac{1}{\sqrt{y}}$

187. $\int \frac{dx}{x^3(a+bx^2)^{\frac{3}{2}}} = \left(-\frac{1}{2ax^2}-\frac{3b}{2a^2}\right)\frac{1}{\sqrt{y}}-\frac{3b}{2a^2}\int\frac{dx}{x\sqrt{y}}$

e. $x^{M}(a+bx^2)^{-\frac{5}{2}}\,dx = x^{M}y^{-\frac{5}{2}}\,dx$

188. $\int\frac{dx}{(x+bx^2)^{\frac{5}{2}}} = \left(\frac{2bx^3}{3a^2}+\frac{x}{a}\right)\frac{1}{y\sqrt{y}}$

189. $\int\frac{x\,dx}{(a+bx^2)^{\frac{5}{2}}} = -\frac{1}{3by\sqrt{y}}$

190. $\int\frac{x^2dx}{(a+bx^2)^{\frac{5}{2}}} = \frac{x^3}{3ay\sqrt{y}}$

191. $\int\frac{x^3dx}{(a+bx^2)^{\frac{5}{2}}} = \left(-\frac{x^2}{b}-\frac{2a}{3b^2}\right)\frac{1}{y\sqrt{y}}$

f. $\frac{dx}{x^{M}(a+bx^2)^{\frac{5}{2}}}\,dx = \frac{dx}{x^{M}y^{\frac{5}{2}}}$

192. $\int\frac{dx}{x(a+bx^2)^{\frac{5}{2}}} = \left(\frac{4}{3a}+\frac{bx^2}{a^2}\right)\frac{1}{y\sqrt{y}}+\frac{1}{a^2}\int\frac{dx}{y\sqrt{y}}$

193. $\int\frac{dx}{x^2(a+bx^2)^{\frac{5}{2}}} = -\frac{1}{axy\sqrt{y}}-\frac{4b}{a}\int\frac{dx}{y}{}^{5}$

194. $\int\frac{dx}{x^3(a+bx^2)^{\frac{5}{2}}} = -\frac{1}{2ax^2y\sqrt{y}}-\frac{5b}{2a}\int\frac{dx}{xy^{\frac{5}{2}}}$

g. $x^{M}\sqrt{(a+bx^2)}\,dx = x^{M}\sqrt{y}\,dx$

195. $\int\sqrt{(a+bx^2)}\,dx = \frac{x\sqrt{y}}{2}+\frac{a}{2}\int\frac{dx}{\sqrt{y}}$

196. $\int x\sqrt{(a+bx^2)}\,dx = \frac{y\sqrt{y}}{3b}$

197. $\int x^2\sqrt{(a+bx^2)}\,dx = \frac{xy\sqrt{y}}{4b}-\frac{a}{4b}\int\sqrt{y}\,dx$

198. $\int x^3\sqrt{(a+bx^2)}\,dx = \left(\frac{x^2}{5b}-\frac{2a}{15b^2}\right)y\sqrt{y}$

Particular values, from $x=0$ to $x=a$; putting $\pi=$ 3.14159.

i. $\int'\sqrt{(a^2-x^2)}\,dx = \frac{\pi a^2}{4}$

ii. $\int x\sqrt{(a^2-x^2)}\,dx = \frac{a^3}{3}$

iii. $\int' x^2\sqrt{(a^2-x^2)}\,dx = \frac{1}{4}\cdot\frac{\pi a^4}{4}$

iv. $\int' x^3\sqrt{(a^2-x^2)}\,dx = \frac{2}{5}\cdot\frac{a^5}{3}$

v. $\int' x^4\sqrt{(a^2-x^2)}\,dx = \frac{1\,.\,3}{4\,.\,6}\cdot\frac{\pi a^6}{4}$

vi. $\int' x^5\sqrt{(a^2-x^2)}\,dx = \frac{2\,.\,4}{5\,.\,7}\cdot\frac{a^7}{3}$

h. $x^{-M}\sqrt{(a+bx^2)}\,dx = x^{-M}\sqrt{y}\,dx$

199. $\int\frac{\sqrt{(a+bx^2)}\,dx}{x} = \sqrt{y}+a\int\frac{dx}{x\sqrt{y}}$

200. $\int\frac{\sqrt{(a+bx^2)}\,dx}{x^2} = -\frac{\sqrt{y}}{x}+b\int\frac{dx}{\sqrt{y}}$

201. $\int\frac{\sqrt{(a+bx^2)}\,dx}{x^3} = -\frac{\sqrt{y}}{2x^2}+\frac{b}{2}\int\frac{dx}{x\sqrt{y}}$

i. $x^{M}(a+bx^2)^{\frac{3}{2}}\,dx = x^{M}y^{\frac{3}{2}}\,dx$

202. $\int(a+bx^2)^{\frac{3}{2}}\,dx = \left(\frac{y}{4}+\frac{3a}{8}\right)x\sqrt{y}+\frac{3a^2}{8}\int\frac{dx}{\sqrt{y}}$

203. $\int x(a+bx^2)^{\frac{3}{2}}\,dx = \frac{x^2\sqrt{y}}{5b}$

204. $\int x^2(a+bx^2)^{\frac{3}{2}}\,dx = \frac{xy^{\frac{5}{2}}}{6b}-\frac{a}{6b}\int y^{\frac{3}{2}}\,dx$

205. $\int x^3(a+bx^2)^{\frac{3}{2}}\,dx = \left(\frac{x^2}{7b}-\frac{2a}{35b^2}\right)y^{\frac{5}{2}}$

Particular values, from $x=0$ to $x=a$; putting $\pi=$ 3.14159.

i. $\int'(a^2-x^2)^{\frac{3}{2}}\,dx = \frac{3\pi a^4}{16}$

ii. $\int' x(a^2-x^2)^{\frac{3}{2}}\,dx = \frac{a^5}{5}$

iii. $\int' x^2(a^2-x^2)^{\frac{3}{2}}\,dx = \frac{1}{6}\cdot\frac{3\pi a^6}{16}$

iv. $\int' x^3(a^2-x^2)^{\frac{3}{2}}\,dx = \frac{2}{7}\cdot\frac{a^7}{5}$

v. $\int' x^4(a^2-x^2)^{\frac{3}{2}}\,dx = \frac{1\,.\,3}{6\,.\,8}\cdot\frac{3\pi a^8}{16}$

vi. $\int' x^5(a^2-x^2)^{\frac{3}{2}}\,dx = \frac{2\,.\,4}{7\,.\,9}\cdot\frac{a^9}{5}$

k. $x^{-M}(a+bx^2)^{\frac{3}{2}}\,dx = x^{-M}y^{\frac{3}{2}}\,dx$

206. $\int\frac{(a+bx^2)^{\frac{3}{2}}dx}{x} = \left(\frac{y}{3}+a\right)\sqrt{y}+a^2\int\frac{dx}{x\sqrt{y}}$

207. $\int\frac{(a+bx^2)^{\frac{3}{2}}dx}{x^2} = -\frac{y^{\frac{5}{2}}}{ax}+\frac{4b}{a}\int y^{\frac{3}{2}}dx$

208. $\int\frac{(a+bx^2)^{\frac{3}{2}}dx}{x^3} = -\frac{y^{\frac{5}{2}}}{2ax^2}+\frac{3b}{2a}\int\frac{y^{\frac{3}{2}}dx}{x}$

l. $x^{M}(a+bx^2)^{\frac{5}{2}}\,dx = x^{M}y^{\frac{5}{2}}\,dx$

209. $\int(a+bx^2)^{\frac{5}{2}}\,dx = \left(\frac{y^2}{6}+\frac{5ay}{24}+\frac{5a^2}{16}\right)x\sqrt{y}+\frac{5a^3}{16}\int\frac{dx}{\sqrt{y}}$

210. $\int x(a+bx^2)^{\frac{5}{2}}\,dx = \frac{y^{\frac{7}{2}}}{7b}$

211. $\int x^2(a+bx^2)^{\frac{5}{2}}\,dx = \frac{xy^{\frac{7}{2}}}{8b}-\frac{a}{8b}\int y^{\frac{5}{2}}\,dx$

212. $\int x^3(a+bx^2)^{\frac{5}{2}}\mathrm{d}x = \left(\frac{x^2}{9b} - \frac{2a}{63b^2}\right) y^{\frac{7}{2}}$

Particular values, from $x =$ to $x = a$; putting $\pi = 3.14159$.

i. $\int' (a^2-x^2)^{\frac{5}{2}}\mathrm{d}x = \frac{5\pi a^6}{32}$

ii. $\int' x(a^2-x^2)^{\frac{5}{2}}\mathrm{d}x = \frac{a^7}{7}$

iii. $\int' x^2(a^2-x^2)^{\frac{5}{2}}\mathrm{d}x = \frac{1}{8}\cdot\frac{5\pi a^8}{32}$

iv. $\int' x^3(a^2-x^2)^{\frac{5}{2}}\mathrm{d}x = \frac{2}{9}\cdot\frac{a^9}{7}$

v. $\int' x^4(a^2-x^2)^{\frac{5}{2}}\mathrm{d}x = \frac{1\,.\,3}{8\,.\,10}\cdot\frac{5\pi a^{10}}{32}$

vi. $\int' x^5(a^2-x^2)^{\frac{5}{2}}\mathrm{d}x = \frac{2\,.\,4}{9\,.\,11}\cdot\frac{a^{11}}{7}$

m. $x^{-\mathrm{M}}(a+bx^2)^{\frac{5}{2}}\mathrm{d}x = x^{-\mathrm{M}}y^{\frac{5}{2}}\mathrm{d}x$

213. $\int\frac{(a+bx^2)^{\frac{5}{2}}}{x} = \left(\frac{y^2}{5} + \frac{ay}{3} + a^2\right)\sqrt{y} + a^3\int\frac{\mathrm{d}x}{x\sqrt{y}}$

214. $\int\frac{(a+bx^2)^{\frac{5}{2}}}{x^2} = -\frac{y^{\frac{7}{2}}}{ax} + \frac{6b}{a}\int y^{\frac{5}{2}}\mathrm{d}x$

215. $\int\frac{(a+bx^2)^{\frac{5}{2}}}{x^3} = -\frac{y^{\frac{7}{2}}}{2ax^2} + \frac{5b}{2a}\int\frac{y^{\frac{5}{2}}\mathrm{d}x}{x}$

E. $x^{\mathrm{m}}(ax+bx^2)^{\frac{\mathrm{n}}{2}}\mathrm{d}x$

a. $x^{\mathrm{M}}(ax+bx^2)^{-\frac{1}{2}}\mathrm{d}x = x^{\mathrm{M}}y^{-\frac{1}{2}}\mathrm{d}x$

216. $\int\frac{\mathrm{d}x}{\sqrt{(ax+bx^2)}} = \frac{1}{\sqrt{b}}\,\mathrm{hl}\,\frac{\sqrt{y}+x\sqrt{b}}{\sqrt{y}-x\sqrt{b}} = \frac{2}{\sqrt{-b}}\,\text{arc tang}\,\frac{x\sqrt{-b}}{\sqrt{y}}$: thus

$$\int\frac{\mathrm{d}x}{\sqrt{(x^2+x)}} = \pm\,\mathrm{hl}\,(2x+1\pm2\sqrt{y})$$

$$\int\frac{\mathrm{d}x}{\sqrt{(x^2-x)}} = \pm\,\mathrm{hl}\,(1-2x\mp2\sqrt{y})$$

217. $\int\frac{x\mathrm{d}x}{\sqrt{(ax+bx^2)}} = \frac{\sqrt{y}}{b} - \frac{a}{2b}\int\frac{\mathrm{d}x}{\sqrt{y}}$

218. $\int\frac{x^2\mathrm{d}x}{\sqrt{(ax+bx^2)}} = \left(\frac{x}{2b} - \frac{3a}{4b^2}\right)\sqrt{y} + \frac{3a^2}{8b^2}\int\frac{\mathrm{d}x}{\sqrt{y}}$

219. $\int\frac{x^3\mathrm{d}x}{\sqrt{(ax+bx^2)}} = \left(\frac{x^2}{3b} - \frac{5ax}{12b^2} + \frac{5a^2}{8b^3}\right)\sqrt{y} - \frac{5a^3}{16b^3}\int\frac{\mathrm{d}x}{\sqrt{y}}$

b. $\frac{\mathrm{d}x}{x^{\mathrm{M}}\sqrt{(ax+bx^2)}} = \frac{\mathrm{d}x}{x^{\mathrm{M}}\sqrt{y}}$

220. $\int\frac{\mathrm{d}x}{x\sqrt{(ax+bx^2)}} = -\frac{2\sqrt{y}}{ax}$

221. $\int\frac{\mathrm{d}x}{x^2\sqrt{(ax+bx^2)}} = \left(-\frac{1}{3ax^2} + \frac{2b}{3a^2x}\right)2\sqrt{y}$

222. $\int\frac{\mathrm{d}x}{x^3\sqrt{(ax+bx^2)}} = \left(-\frac{1}{5ax^3} + \frac{4b}{15a^2x^2} - \frac{8b^2}{15a^3x}\right)2\sqrt{y}$

c. $x^{\mathrm{M}}(ax+bx^2)^{-\frac{3}{2}}\mathrm{d}x$

223. $\int\frac{\mathrm{d}x}{(ax+bx^2)^{\frac{3}{2}}} = -\frac{2(2bx+a)}{a^2\sqrt{y}}$

224. $\int\frac{x\mathrm{d}x}{(ax+bx^2)^{\frac{3}{2}}} = \frac{2x}{a\sqrt{y}}$

225. $\int\frac{x^2\mathrm{d}x}{(ax+bx^2)^{\frac{3}{2}}} = -\frac{2x}{\sqrt{y}} + \frac{1}{b}\int\frac{\mathrm{d}x}{\sqrt{y}}$

226. $\int\frac{x^3\mathrm{d}x}{(ax+bx^2)^{\frac{3}{2}}} = \left(\frac{x^2}{b} + \frac{3ax}{b^2}\right)\frac{1}{\sqrt{y}} - \frac{3a}{2b^2}\int\frac{\mathrm{d}x}{\sqrt{y}}$

d. $\frac{\mathrm{d}x}{x^{\mathrm{M}}(ax+bx^2)^{\frac{3}{2}}} = \frac{\mathrm{d}x}{x^{\mathrm{M}}y^{\frac{3}{2}}}$

227. $\int\frac{\mathrm{d}x}{x(x+bx^2)^{\frac{3}{2}}} = -\frac{2}{3ax\sqrt{y}} - \frac{4b}{3a}\int\frac{\mathrm{d}x}{y^{\frac{3}{2}}}$

228. $\int\frac{\mathrm{d}x}{x^2(ax+bx^2)^{\frac{3}{2}}} = \left(-\frac{1}{5ax^2} + \frac{2b}{5a^2x}\right)\frac{2}{\sqrt{y}} + \frac{8b^2}{5a^2}\int\frac{\mathrm{d}x}{y^{\frac{3}{2}}}$

229. $\int\frac{\mathrm{d}x}{x^3(ax+bx^2)^{\frac{3}{2}}} = \left(=\frac{1}{7ax^3} + \frac{8b}{35a^2x^2} - \frac{16b^2}{35a^3x}\right)\frac{2}{\sqrt{y}} - \frac{64b^3}{35a^3}\int\frac{\mathrm{d}x}{y^{\frac{3}{2}}}$

e. $x^{\mathrm{M}}(ax+bx^2)^{-\frac{5}{2}}\mathrm{d}x = x^{\mathrm{M}}y^{-\frac{5}{2}}\mathrm{d}x$

230. $\int\frac{\mathrm{d}x}{(ax+bx^2)^{\frac{5}{2}}} = \left(-\frac{2}{3y} + \frac{16b}{3a^2}\right)\frac{2bx+a}{a^2\sqrt{y}}$

231. $\int\frac{x\mathrm{d}x}{(ax+bx^2)^{\frac{5}{2}}} = \frac{2x}{3ay\sqrt{y}} - \frac{8(2bx+a)}{3a^3\sqrt{y}} = \left(\frac{1}{a+bx} - \frac{4(2bx+a)}{a^2}\right)\frac{2}{3a\sqrt{y}}$

232. $\int\frac{x^2\mathrm{d}x}{(ax+bx^2)^{\frac{5}{2}}} = \left(\frac{2x^2}{3ay} + \frac{4x}{3a^2}\right)\frac{1}{\sqrt{y}}$

233. $\int\frac{x^3\mathrm{d}x}{(ax+bx^2)^{\frac{5}{2}}} = \frac{2x^3}{3ay\sqrt{y}}$

f. $\frac{\mathrm{d}x}{x^{\mathrm{M}}(ax+bx^2)^{\frac{5}{2}}} = \frac{\mathrm{d}x}{x^{\mathrm{M}}y^{\frac{5}{2}}}$

234. $\int\frac{\mathrm{d}x}{x(ax+bx^2)^{\frac{5}{2}}} = -\frac{2}{5axy\sqrt{-y}} - \frac{8b}{5a}\int\frac{\mathrm{d}x}{y^{\frac{5}{2}}}$

235. $\int\frac{\mathrm{d}x}{x^2(ax+bx^2)^{\frac{5}{2}}} = \left(-\frac{1}{7ax^2} + \frac{2b}{7a^2x}\right)\frac{2}{y\sqrt{y}} + \frac{16b^2}{7a^2}\int\frac{\mathrm{d}x}{y^{\frac{5}{2}}}$

236. $\int\frac{\mathrm{d}x}{x^3(ax+bx^2)^{\frac{5}{2}}} = \left(-\frac{1}{9ax^3} + \frac{4b}{21a^2x^2} - \frac{8b^2}{21a^3x}\right)\frac{2}{y\sqrt{y}} - \frac{64b^3}{21a^3}\int\frac{\mathrm{d}x}{y^{\frac{5}{2}}}$

g. $x^{M}\surd(ax+bx^2)\mathrm{d}x=x^{M}\surd y\mathrm{d}x$

237. $\int\surd(ax+bx^2)\mathrm{d}x=\left(\frac{x}{2}+\frac{a}{4b}\right)\surd y-\frac{a^2}{8b}\int\frac{\mathrm{d}x}{\surd y}$; thus

$\int\surd(ax-x^2)\mathrm{d}x=\frac{1}{2}$circ. segm diam a vers sin x.

238. $\int x\surd(ax+bx^2)\mathrm{d}x=\frac{y\surd y}{3b}-\frac{a}{2b}\int\surd y\mathrm{d}x$

239. $\int x^2\surd(ax+bx^2)\mathrm{d}x=\left(\frac{x}{4b}-\frac{5a}{24b^2}\right)y\surd y+\frac{5a^2}{16b^2}\int\surd y\mathrm{d}x$

240. $\int x^3\surd(ax+bx^2)\mathrm{d}x=\left(\frac{x^2}{5b}-\frac{7ax}{40b^2}+\frac{7a^2}{48b^3}\right)y\surd y-\frac{7a^3}{32b^3}\int\surd y\mathrm{d}x$

h. $x^{-M}\surd(ax+bx^2)\mathrm{d}x=x^{-M}\surd y\mathrm{d}x$

241. $\int\frac{\surd(ax+bx^2)\mathrm{d}x}{x}=\surd y+\frac{a}{2}\int\frac{\mathrm{d}x}{\surd y}$

242. $\int\frac{\surd(ax+bx^2)\mathrm{d}x}{x^2}=-\frac{2\surd y}{x}+b\int\frac{\mathrm{d}x}{\surd y}$

243. $\int\frac{\surd(ax+bx^2)\mathrm{d}x}{x^3}=-\frac{2y\surd y}{3ax^3}$

i. $x^{M}(ax+bx^2)^{\frac{3}{2}}\mathrm{d}x=x^{M}y^{\frac{3}{2}}\mathrm{d}x$

244. $(ax+bx^2)^{\frac{3}{2}}\mathrm{d}x=\left(\frac{y}{b}-\frac{3a^2}{8b^2}\right)\frac{2bx+a}{8}\surd y+\frac{3a^4}{128b^2}\int\frac{\mathrm{d}x}{\surd y}$

245. $\int x(ax+bx^2)^{\frac{3}{2}}\mathrm{d}x=\frac{y^{\frac{5}{2}}}{5b}-\frac{a}{2b}\int y^{\frac{3}{2}}\mathrm{d}x$

246. $\int x^2(ax+bx^2)^{\frac{3}{2}}\mathrm{d}x=\left(\frac{x}{6b}-\frac{7a}{60b^2}\right)y^{\frac{5}{2}}+\frac{7a^2}{24b^2}\int y^{\frac{3}{2}}\mathrm{d}x$

247. $\int x^3(ax+bx^2)^{\frac{3}{2}}\mathrm{d}x=\left(\frac{x^2}{7b}-\frac{3ax}{28b^2}+\frac{3a^2}{40b^3}\right)y^{\frac{5}{2}}\ \frac{3a^3}{16b^3}-\int y^{\frac{3}{2}}\mathrm{d}x$

k. $x^{-M}(ax+bx^2)^{\frac{3}{2}}\mathrm{d}x=x^{-M}y^{\frac{3}{2}}\mathrm{d}x$

248. $\int\frac{(ax+bx^{2\frac{3}{2}}\mathrm{d}x}{x}=\frac{y\surd y}{3}+\frac{a}{2}\int\surd y\mathrm{d}x$

249. $\int\frac{(ax+bx^2)^{\frac{3}{2}}\mathrm{d}x}{x^2}=\left(\frac{5a}{4}+\frac{bx}{2}\right)\surd y+\frac{3a^2}{8}\int\frac{\mathrm{d}x}{\surd y}$

250. $\int\frac{(ax+bx^2)^{\frac{3}{2}}\mathrm{d}x}{x^3}=\left(b-\frac{2a}{x}\right)\surd y+\frac{3ab}{2}\int\frac{\mathrm{d}x}{\surd y}$

l. $x^{M}(ax+bx^2)^{\frac{5}{2}}\mathrm{d}x=x^{M}y^{\frac{5}{2}}\mathrm{d}x$

251. $\int(ax+bx^2)^{\frac{5}{2}}\mathrm{d}x=\left(\frac{y^2}{b}-\frac{5a^2y}{16b^2}+\frac{15a^4}{128b^3}\right)\frac{2bx+a}{12}\surd y-\frac{5a^6}{1024b^3}\int\frac{\mathrm{d}x}{\surd y}$

252. $\int x(ax+ax^2)^{\frac{5}{2}}\mathrm{d}x=\frac{y^{\frac{7}{2}}}{7b}-\frac{a}{2b}\int y^{\frac{5}{2}}\mathrm{d}x$

253. $\int x^2(ax+bx^2)^{\frac{5}{2}}\mathrm{d}x=\left(\frac{x}{8b}-\frac{9a}{112b^2}\right)y^{\frac{7}{2}}+\frac{9a^2}{32b^2}\int y^{\frac{5}{2}}\mathrm{d}x$

254. $\int x^3(ax+bx^2)^{\frac{5}{2}}\mathrm{d}x=\left(\frac{x^2}{9b}-\frac{11ax}{144b^2}+\frac{11a^2}{224b^3}\right)y^{\frac{7}{2}}-\frac{11a^3}{64b^3}\int y^{\frac{5}{2}}\mathrm{d}x$

m. $x^{-M}(ax+bx^2)^{\frac{5}{2}}\mathrm{d}x=x^{-M}y^{\frac{5}{2}}\mathrm{d}x$

255. $\int\frac{(ax+bx^2)^{\frac{5}{2}}\mathrm{d}x}{x}=\frac{y^{\frac{5}{2}}}{5}+\frac{a}{2}\int y^{\frac{3}{2}}\mathrm{d}x$

256. $\int\frac{(ax+bx^2)^{\frac{5}{2}}\mathrm{d}x}{x^2}=\left(\frac{y^2}{4x}+\frac{5ay}{24}\right)\surd y+\frac{5a^2}{16}\int\surd y\mathrm{d}x$

257. $\int\frac{(ax+bx^2)^{\frac{5}{2}}\mathrm{d}x}{x^3}=\left(\frac{y^2}{3x^2}+\frac{5ay}{12x}+\frac{5a^2}{8}\right)\surd y+\frac{5a^3}{16}\int\frac{\mathrm{d}x}{\surd y}$

F. $x^{m}(a+bx+cx^2)^{\frac{n}{2}}\mathrm{d}x$

a. $x^{M}(a+bx+cx^2)^{-\frac{1}{2}}\mathrm{d}x=x^{M}y^{-\frac{1}{2}}\mathrm{d}x$

258. $\int\frac{\mathrm{d}x}{\surd(a+bx+cx^2)}=\frac{\pm1}{\surd c}$ hl $(2cx+b\pm2\surd c\surd y)$ $=\frac{-1}{\surd-c}$ arc sin $\frac{2cx+b}{\surd(b^2-4ac)}$

259. $\frac{x\mathrm{d}x}{\surd(a+bx+cx^2)}=\frac{\surd y}{c}-\frac{b}{2c}\int\frac{\mathrm{d}x}{\surd y}$

260. $\int\frac{x^2\mathrm{d}x}{\surd(a+bx+cx^2)}=\left(\frac{x}{2c}-\frac{3b}{4c^2}\right)\surd y+\left(\frac{3b^2}{8c^2}-\frac{a}{2c}\right)\int\frac{\mathrm{d}x}{\surd y}$

261. $\int\frac{x^3\mathrm{d}x}{\surd(a+bx+cx^2)}=\left(\frac{x^2}{3c}-\frac{5b^2}{12c^2}+\frac{5b^2}{8c^3}-\frac{2a}{3c^2}\right)\surd y-\left(\frac{5b^3}{16c^3}-\frac{3ab}{4c^2}\right)\int\frac{\mathrm{d}x}{\surd y}$

b. $\frac{dx}{x^{M}\sqrt{(a+bx+cx^2)}}=\frac{dx}{x^{M}\sqrt{y}}$

262. $\int\frac{dx}{x\sqrt{(a+bx+cx)}}=\pm\frac{1}{\sqrt{a}}\,\mathrm{hl}\,\frac{2a+bx\pm2\sqrt{a}\sqrt{y}}{x}$

$=\frac{1}{\sqrt{-a}}\,\text{arc tang}\,\frac{2a+bx}{2\sqrt{-a}\sqrt{y}}$

263. $\int\frac{dx}{x^2\sqrt{(a+bx+cx^2)}}=-\frac{\sqrt{y}}{ax}-\frac{b}{2a}\int\frac{dx}{x\sqrt{y}}$

264. $\int\frac{dx}{x^3\sqrt{(a+bx+cx^2)}}=\left(-\frac{1}{2ax^2}+\frac{3b}{4a^2x}\right)\sqrt{y}$
$+\left(\frac{3b^2}{8a^2}-\frac{c}{2a}\right)\int\frac{dx}{x\sqrt{y}}$

c. $x^{M}(a+bx+cx^2)^{-\frac{3}{2}}dx=x^{M}y^{-\frac{3}{2}}dx$

265. $\int\frac{dx}{(a+bx+cx^2)^{\frac{3}{2}}}=\frac{4cx+2b}{(4ac-b^2)\sqrt{y}}$

266. $\int\frac{x\,dx}{(a+bx+cx^2)^{\frac{3}{2}}}=-\frac{4a+2bx}{(4ac-b^2)\sqrt{y}}$

267. $\int\frac{x^2dx}{(a+bx+cx^2)^{\frac{3}{2}}}=-\frac{(4ac-2b^2)x-2ab}{c(4ac-b^2)\sqrt{y}}+\frac{1}{c}$
$\int\frac{dx}{\sqrt{y}}$

268. $\int\frac{x^3dx}{(x+bx+cx^2)^{\frac{3}{2}}}=\frac{x^2}{c\sqrt{y}}-\frac{2a}{c}\int\frac{x\,dx}{y^{\frac{3}{2}}}-\frac{3b}{2c}$
$\int\frac{x^2dx}{y^{\frac{3}{2}}}$

d. $\frac{dx}{x^{M}(a+bx+cx^2)^{\frac{3}{2}}}=\frac{dx}{x^{M}y^{\frac{3}{2}}}$

269. $\int\frac{dx}{x(a+bx+cx^2)^{\frac{3}{2}}}=\frac{1}{a\sqrt{y}}-\frac{b}{2a}\int\frac{dx}{y^{\frac{3}{2}}}+\frac{1}{a}$
$\int\frac{dx}{x\sqrt{y}}$

270. $\int\frac{dx}{x^2(a+bx+cx^2)^{\frac{3}{2}}}=\left(-\frac{1}{ax}-\frac{3b}{2a^2}\right)\frac{1}{\sqrt{y}}+$
$\left(\frac{3b^2}{4a^2}-\frac{2c}{a}\right)\int\frac{dx}{y^{\frac{3}{2}}}-\frac{3b}{2a^2}\int\frac{dx}{x\sqrt{y}}$

271. $\int\frac{dx}{(x^3a+bx+cx^2)^{\frac{3}{2}}}=\left(-\frac{1}{2ax^2}+\frac{5b}{4a^2x}+\frac{15a^2}{8a^3}\right.$
$\left.-\frac{3c}{2a^2}\right)\frac{1}{\sqrt{y}}-\left(\frac{15b^3}{16a^3}-\frac{13bc}{4a^2}\right)\int\frac{dx}{y^{\frac{3}{2}}}+$
$\left(\frac{15b^2}{8a^3}-\frac{3c}{2a^2}\right)\int\frac{dx}{x\sqrt{y}}$

e. $x^{M}(a+bx+cx^2)^{-\frac{5}{2}}dx=x^{M}y^{-\frac{5}{2}}dx$

272. $\int\frac{dx}{(a+bx+cx^2)^{\frac{5}{2}}}=\left(\frac{1}{(4ac-b^2)y}+\right.$
$\left.\frac{8c}{3(4ac-b^2)^2}\right)\frac{4cx+2b}{\sqrt{y}}$

273. $\int\frac{x\,dx}{(a+bx+cx^2)^{\frac{5}{2}}}=-\frac{1}{3cy\sqrt{y}}-\frac{b}{2c}\int\frac{dx}{y^{\frac{5}{2}}}$

274. $\int\frac{x^2dx}{(a+bx+cx^2)^{\frac{5}{2}}}=\left(-\frac{x}{2c}+\frac{1}{12c^2}\right)\frac{1}{y\sqrt{y}}+$
$\left(\frac{b^2}{8c^2}+\frac{a}{2c}\right)\int\frac{dx}{y^{\frac{5}{2}}}$

275. $\int\frac{x^3dx}{(a+bx+cx^2)^{\frac{5}{2}}}=\left(-\frac{x^2}{c}-\frac{bx}{4c^2}+\frac{b^2}{24c^3}-\right.$
$\left.\frac{2a}{3c^2}\right)\frac{1}{y\sqrt{y}}+\left(\frac{b^3}{16c^3}-\frac{3ab}{4c^2}\right)\int\frac{dx}{y^{\frac{5}{2}}}$

f. $\frac{dx}{x^{M}(a+bx+cx^2)^{\frac{5}{2}}}=\frac{dx}{x^{M}y^{\frac{5}{2}}}$

276. $\int\frac{dx}{x(a+bx+cx^2)^{\frac{5}{2}}}=\left(\frac{1}{3ay}+\frac{1}{a^2}\right)\frac{1}{\sqrt{y}}-\frac{b}{2a}$
$\int\frac{dx}{y^{\frac{5}{2}}}-\frac{b}{2a^2}\int\frac{dx}{y^{\frac{5}{2}}}+\frac{1}{a^{\frac{1}{2}}}\int\frac{dx}{x\sqrt{y}}$

277. $\int\frac{dx}{x^2(a+bx+cx^2)^{\frac{5}{2}}}=-\frac{1}{axy\sqrt{y}}-\frac{5b}{2a}\int\frac{dx}{xy^{\frac{5}{2}}}$
$-\frac{4c}{a}\int\frac{dx}{y^{\frac{5}{2}}}$

278. $\int\frac{dx}{x^3(a+bx+cx^2)^{\frac{5}{2}}}=\left(-\frac{1}{2ax^2}+\frac{7b}{4a^2x}\right)\frac{1}{y\sqrt{y}}$
$+\left(\frac{35b^2}{8a^2}-\frac{5c}{2a}\right)\int\frac{dx}{xy^{\frac{5}{2}}}+\frac{7bc}{a^2}\int\frac{dx}{y^{\frac{5}{2}}}$

g. $x^{M}\sqrt{(a+bx+cx^2)}dx=x^{M}\sqrt{y}dx$

279. $\int\sqrt{(a+bx+cx^2)}dx=\frac{2cx+b}{4c}\sqrt{y}+\frac{4ac-b^2}{8c}$
$\int\frac{dx}{\sqrt{y}}$

280. $\int x\sqrt{(a+bx+cx^2)}dx=\frac{y\sqrt{y}}{3c}-\frac{b}{2c}\int\sqrt{y}dx$

281. $\int x^2\sqrt{(a+bx+cx^2)}dx=\left(\frac{x}{4c}-\frac{5b}{24c^2}\right)y\sqrt{y}$
$+\left(\frac{5b^2}{16c^2}-\frac{a}{4c}\right)\int\sqrt{y}dx$

282. $\int x^3\sqrt{(a+bx+cx^2)}dx=\left(\frac{x^2}{5c}-\frac{7bx}{40c^2}+\frac{7b^2}{48c^3}-\right.$
$\left.\frac{2a}{15c^2}\right)y\sqrt{y}-\left(\frac{7b^3}{32c^3}-\frac{3ab}{8c^3}\right)\int\sqrt{y}dx$

h. $x^{-M}\sqrt{(a+bx+cx^2)}dx=x^{-M}\sqrt{y}dx$

283. $\int\frac{\sqrt{(a+bx+cx^2)}dx}{x}=\sqrt{y}+a\int\frac{dx}{x\sqrt{y}}+\frac{b}{2}\int\frac{dx}{\sqrt{y}}$

284. $\int\frac{\sqrt{(a+bx+cx^2)}dx}{x^2}=-\frac{\sqrt{y}}{x}+\frac{b}{2}\int\frac{dx}{x\sqrt{y}}+$
$c\int\frac{dx}{\sqrt{y}}$

285. $\int\frac{\sqrt{(a+bx+cx^2)}dx}{x^3}=-\left(\frac{1}{2x^2}+\frac{b}{4ax}\right)\sqrt{y}-$
$\left(\frac{b^2}{8a}-\frac{c}{2}\right)\int\frac{dx}{x\sqrt{y}}$

i. $x^{M}(a+bx+cx^2)^{\frac{3}{2}}dx=x^{M}y^{\frac{3}{2}}dx$

286. $\int(a+bx+cx^2)^{\frac{3}{2}}dx=\left(\frac{y}{8c}+\frac{12ac-3b^2}{64c^2}\right)(2cx+b)\sqrt{y}+12ac\frac{3(4ac-b^2)^2}{128c^2}\int\frac{dx}{\sqrt{y}}$

287. $\int x(a+bx+cx^2)^{\frac{3}{2}}dx=\frac{y^{\frac{5}{2}}}{5c}-\frac{b}{2c}\int y^{\frac{3}{2}}dx$

288. $\int x^2(a+bx+cx^2)^{\frac{3}{2}}dx=\left(\frac{x}{6c}-\frac{7b}{60c^2}\right)y^{\frac{5}{2}}+\left(\frac{7b^2}{24c^2}-\frac{a}{6c}\right)\int y^{\frac{3}{2}}dx$

289. $\int x^3(a+bx+cx^2)^{\frac{3}{2}}dx=\left(\frac{x^2}{7c}-\frac{3bx}{28c^2}+\frac{3b^2}{40c^3}-\frac{2a}{35c^2}\right)y^{\frac{5}{2}}-\left(\frac{3b^3}{16c^3}-\frac{ab}{4c^2}\right)\int y^{\frac{3}{2}}dx$

k. $x^{-M}(a+bx+cx^2)^{\frac{3}{2}}dx=x^{-M}y^{\frac{3}{2}}dx$

290. $\int\frac{(a+bx+cx^3)^{\frac{3}{2}}dx}{x}=\left(\frac{y}{3}+a\right)\sqrt{y}+a^2\int\frac{dx}{x\sqrt{y}}+\frac{ab}{2}\int\frac{dx}{\sqrt{y}}+\frac{b}{2}\int\sqrt{y}dx$

291. $\int\frac{(a+bx+cx^2)^{\frac{3}{2}}dx}{x^2}=-\frac{y^{\frac{5}{2}}}{ax}+\frac{3b}{2a}\int\frac{y^{\frac{3}{2}}dx}{x}+\frac{4c}{a}\int y^{\frac{3}{2}}dx$

292. $\int\frac{(a+bx+cx^2)^{\frac{3}{2}}dx}{x^3}=\left(-\frac{1}{2ax^2}-\frac{b}{4a^2x}\right)y^{\frac{5}{2}}+\left(\frac{3b^2}{8a^2}+\frac{3c}{2a}\right)\int\frac{y^{\frac{3}{2}}dx}{x}+\frac{bc}{a^2}\int y^{\frac{3}{2}}dx$

l. $x^{M}(a+bx+cx^2)^{\frac{5}{2}}dx=x^{M}y^{\frac{5}{2}}dx$

293. $\int(a+bx+ca^2)^{\frac{5}{2}}dx=\left(\frac{y^2}{12c}+\frac{5(4ac-b^2)y}{192c^2}+\frac{5(4ac-b^2)^2}{512c^3}\right)(2cx+b)\sqrt{y}+\frac{5(4ac-b^2)^3}{1024c^3}\int\frac{dx}{\sqrt{y}}$

294. $\int x(a+bx+cx^2)^{\frac{5}{2}}dx=\frac{y^{\frac{7}{2}}}{7c}-\frac{b}{2c}\int y^{\frac{5}{2}}dx$

295. $\int x^2(a+bx+cx^2)^{\frac{5}{2}}dx=\left(\frac{x}{8c}-\frac{9b}{112c^2}\right)y^{\frac{7}{2}}+\left(\frac{9b^2}{32c^2}-\frac{a}{8c}\right)\int y^{\frac{5}{2}}dx$

296. $\int x^3(a+bx+cx^2)^{\frac{5}{2}}dx=\left(\frac{x^2}{9c}-\frac{11bx}{144c^2}+\frac{11b^2}{224c^3}-\frac{2a}{63c^2}\right)y^{\frac{7}{2}}-\left(\frac{11b^3}{64c^3}-\frac{3ax}{16c^2}\right)\int y^{\frac{5}{2}}dx$

m. $x^{-M}(a+bx+cx^2)^{\frac{5}{2}}dx=x^{-M}y^{\frac{5}{2}}dx$

297. $\int\frac{(a+bx+cx^2)^{\frac{5}{2}}dx}{x}=\left(\frac{y^2}{5}+\frac{ay}{3}+a^2\right)\sqrt{y}+a^3\int\frac{dx}{x\sqrt{y}}+\frac{a^2b}{2}\int\frac{dx}{\sqrt{y}}+\frac{ab}{2}\int\sqrt{y}dx+\frac{b}{2}\int y^{\frac{3}{2}}dx$

298. $\int\frac{(a+bx+cx^2)^{\frac{5}{2}}dx}{x^2}=-\frac{y^{\frac{7}{2}}}{ax}+\frac{5b}{2a}\int\frac{y^{\frac{5}{2}}dx}{x}+\frac{6c}{a}\int y^{\frac{5}{2}}dx$

299. $\int\frac{(a+bx+cx^2)^{\frac{5}{2}}dx}{x^3}=\left(-\frac{1}{2ax^2}-\frac{3b}{4a^2x}\right)y^{\frac{7}{2}}+\left(\frac{15b^2}{8a^2}+\frac{5c}{2a}\right)\int\frac{y^{\frac{5}{2}}dx}{x}+\frac{9bc}{2a^2}\int y^{\frac{5}{2}}dx$

G. $x^{\frac{m}{2}}(a+bx)^{n}dx$

300. $\int x^{\frac{m}{2}}(a+bx)^{n}dx=\int x^{\frac{m}{2}}y^{n}dx=\int\left(\frac{y-a}{b}\right)^{\frac{m}{2}}y^{n}\frac{dy}{b}=\left(\frac{1}{b}\right)^{\frac{m}{2}+1}\int(-a+y)^{\frac{m}{2}}y^{n}dy.$

(A): thus

$\int\frac{dx}{\sqrt{x(a+bx)}}=\pm\frac{2}{\sqrt{(ab)}}\text{ arc tang }\sqrt{\frac{bx}{a}}=\frac{1}{\sqrt{(-ab)}}\text{hl}\frac{a-bx+2\sqrt{x}\sqrt{(-ab)}}{a+bx}$

H. $\frac{x^{M-\frac{1}{2}}dx}{(a+bx^2)^{N}}$

a. $\frac{x^{M}dx}{\sqrt{x}(a+bx^2)}=\frac{x^{M}dx}{\sqrt{xy}}$

301. $\int\frac{dx}{\sqrt{x}(a+bx^2)}=\frac{1}{\sqrt{2b}}\left(\frac{b}{a}\right)^{\frac{3}{4}}\left(\text{hl}\frac{+x\left(\frac{a}{b}\right)^{\frac{1}{4}}\sqrt{(2x)}+\left(\frac{a}{b}\right)^{\frac{1}{2}}}{\sqrt{y}}+\text{arc tang}\frac{\left(\frac{a}{b}\right)^{\frac{1}{4}}\sqrt{(2x)}}{\left(\frac{a}{b}\right)^{\frac{1}{2}}-x}\right)$

$=\frac{1}{2b}\left(-\frac{b}{a}\right)^{\frac{3}{4}}\left(\text{hl}\frac{\left(-\frac{a}{b}\right)^{\frac{1}{4}}-\sqrt{x}}{\left(-\frac{a}{b}\right)^{\frac{1}{4}}+\sqrt{x}}-2\text{ arc tang}\frac{\sqrt{x}}{\left(-\frac{a}{b}\right)^{\frac{1}{4}}}\right)$

302. $\int\frac{\sqrt{x}dx}{a+bx^2}=\frac{1}{\sqrt{2b}}\left(\frac{b}{a}\right)^{\frac{1}{4}}\left(-\text{hl}\frac{x+\left(\frac{a}{b}\right)^{\frac{1}{2}}+\left(\frac{a}{b}\right)^{\frac{1}{4}}\sqrt{(2x)}}{\sqrt{y}}\right.$

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$$+ \text{arc tang}\frac{\left(\frac{a}{b}\right)^{\frac{1}{4}}\sqrt{(2x)}}{\left(\frac{a}{b}\right)^{\frac{1}{2}}-x}\Bigg)$$

$$=\frac{1}{2b}\left(-\frac{b}{a}\right)^{\frac{1}{4}}\left(\text{hl}\frac{\left(-\frac{a}{b}\right)^{\frac{1}{4}}-\sqrt{x}}{\left(-\frac{a}{b}\right)^{\frac{1}{4}}+\sqrt{x}}+\right.$$

$$\left.2\text{ arc tang}\frac{\sqrt{x}}{\left(-\frac{a}{b}\right)^{\frac{1}{4}}}\right)$$

303. $\int\frac{x\sqrt{x}\,dx}{a+bx^2}=\frac{2\sqrt{x}}{b}-\frac{a}{b}\int\frac{dx}{y\sqrt{x}}$

304. $\int\frac{x^2\sqrt{x}dx}{a+bx^2}=\frac{2x\sqrt{x}}{3b}-\frac{a}{b}\int\frac{\sqrt{x}dx}{y}$

b. $\frac{x^{\text{M}}dx}{\sqrt{x}(a+bx^2)^2}=\frac{x^{\text{M}}dx}{\sqrt{x}y^2}$

305. $\int\frac{dx}{\sqrt{x}(a+bx^2)^2}=\frac{\sqrt{x}}{2ay}+\frac{3}{4a}\int\frac{dx}{\sqrt{x}y}$

306. $\int\frac{\sqrt{x}dx}{(a+bx^2)^2}=\frac{x\sqrt{x}}{2ay}+\frac{1}{4a}\int\frac{\sqrt{x}dx}{y}$

307. $\int\frac{x\sqrt{x}dx}{(a+bx^2)^2}=-\frac{\sqrt{x}}{2by}+\frac{1}{4b}\int\frac{dx}{\sqrt{x}y}$

308. $\int\frac{x^2\sqrt{x}dx}{(a+bx^2)^2}=-\frac{x\sqrt{x}}{2by}+\frac{3}{4b}\int\frac{\sqrt{x}dx}{y}$

c. $\frac{x^{\text{M}}dx}{\sqrt{x}(a+bx^2)^3}=\frac{a^{\text{M}}dx}{\sqrt{x}y^3}$

309. $\int\frac{dx}{\sqrt{x}(a+bx^2)^3}=\left(\frac{1}{4ay^2}+\frac{7}{16a^2y}\right)\sqrt{x}+\frac{21}{32a^2}\int\frac{dx}{\sqrt{x}y}$

310. $\int\frac{\sqrt{x}dx}{(a+bx^2)^3}=\left(\frac{1}{4ay^2}+\frac{5}{16a^2y}\right)x\sqrt{x}+\frac{5}{32a^2}\int\frac{\sqrt{x}dx}{y}$

311. $\int\frac{x\sqrt{x}dx}{(a+bx^2)^3}=\frac{(bx^2-3a)\sqrt{x}}{16aby^2}+\frac{3}{32ab}\int\frac{dx}{\sqrt{x}y}$

312. $\int\frac{x^2\sqrt{x}dx}{(a+bx^2)^3}=-\frac{2x\sqrt{x}}{5by^2}+\frac{3a}{5b}\int\frac{\sqrt{x}dx}{y^3}$

I. $x^{\text{m}}(f+gx)^{-\text{N}}(a+bx)^{-\frac{1}{2}}dx=x^{\text{m}}y^{-\text{N}}z^{-\frac{1}{2}}dx$

a. $x^{\text{M}}(f+gx)^{-1}(a+bx)^{-\frac{1}{2}}dx=x^{\text{M}}y^{-1}z^{-\frac{1}{2}}dx$

313. $\int\frac{dx}{(f+gx)\sqrt{(a+bx)}}=\pm\frac{2}{\sqrt{(bfg-ag^2)}}\text{ arc tang}\sqrt{\frac{gz}{bf-ag}}=\frac{1}{\sqrt{(ag^2-bfg)}}\text{hl}\frac{bf-2ag-bgx+2\sqrt{(ag^2-bfg)}\sqrt{z}}{y}$

314. $\int\frac{xdx}{(f+gx)\sqrt{(a+bx)}}=\frac{1}{g}\int\frac{dx}{\sqrt{z}}-\frac{f}{g}\int\frac{dz}{y\sqrt{z}}$

315. $\int\frac{x^2dx}{(f+gx)\sqrt{(a+bx)}}=\frac{1}{g}\int\frac{xdx}{\sqrt{z}}-\frac{f}{g^2}\int\frac{dx}{\sqrt{z}}+\frac{f^2}{g^2}\int\frac{dx}{y\sqrt{z}}$

316. $\int\frac{x^3dx}{(f+gx)\sqrt{(a+bx)}}=\frac{1}{g}\int\frac{x^2dx}{\sqrt{z}}-\frac{f}{g^2}\int\frac{xdx}{\sqrt{z}}+\frac{f^2}{g^3}\int\frac{dx}{\sqrt{z}}-\frac{f^3}{g^3}\int\frac{dx}{y\sqrt{z}}$

b. $x^{\text{M}}(f+gx)^{-2}(a+bx)^{-\frac{1}{2}}dx=x^{\text{M}}y^{-2}z^{-\frac{1}{2}}dx$

317. $\int\frac{dx}{(f+gx)^2\sqrt{(a+bx)}}=\frac{\sqrt{z}}{(bf-ag)y}+\frac{b}{2bf-2ag}\int\frac{dx}{y\sqrt{z}}$

318. $\int\frac{xdx}{(f+gx)^2\sqrt{(a+bx)}}=\frac{1}{g}\int\frac{dx}{y\sqrt{z}}-\frac{f}{g}\int\frac{dx}{y^2\sqrt{z}}$

319. $\int\frac{x^2dx}{(f+gx)^2\sqrt{(a+bx)}}=\frac{1}{g^2}\int\frac{dx}{\sqrt{z}}-\frac{2f}{g^2}\int\frac{dx}{y\sqrt{z}}+\frac{f^2}{g^2}\int\frac{dx}{y^2\sqrt{z}}$

320. $\int\frac{x^3dx}{(f+gx)^2\sqrt{(a+bx)}}=\frac{1}{g^2}\int\frac{xdx}{\sqrt{z}}-\frac{2f}{g^3}\int\frac{dx}{\sqrt{z}}+\frac{3f^2}{g^3}\int\frac{dx}{y\sqrt{z}}-\frac{f^3}{g^3}\int\frac{dx}{y^2\sqrt{z}}$

c. $x^{\text{M}}(f+gx)^{-3}(a+bx)^{-\frac{1}{2}}dx=^{\text{M}}y^{-3}z^{-\frac{1}{2}}dx$

321. $\int\frac{dx}{(f+gx)^3\sqrt{(a+bx)}}=\left(\frac{1}{2(bf-ag)y^2}+\frac{3b}{4(bf-ag)^2y}\right)\sqrt{z}+\frac{3b^2}{8(bf-ag)^2}\int\frac{dx}{y\sqrt{z}}$

322. $\int\frac{xdx}{(f+gx)^3\sqrt{(a+bx)}}=\frac{1}{g}\int\frac{dx}{y^2\sqrt{z}}\,\frac{f}{g}\int\frac{dx}{y^3\sqrt{z}}$

323. $\int\frac{x^2dx}{(f+gx)^3\sqrt{(a+bx)}}=\frac{1}{g^2}\int\frac{dx}{y\sqrt{z}}-\frac{2f}{g^2}\int\frac{dx}{y^2\sqrt{z}}+\frac{f^2}{g^2}\int\frac{dx}{y^3\sqrt{z}}$

324. $\int\frac{x^3dx}{(f+gx)^3\sqrt{(a+bx)}}=\frac{1}{g^3}\int\frac{dx}{\sqrt{z}}-\frac{3f}{g^3}\int\frac{dx}{y\sqrt{z}}+\frac{3f^2}{g^3}\int\frac{dx}{y^2\sqrt{z}}-\frac{f^3}{g^3}\int\frac{dx}{y^3\sqrt{z}}$

d. $\frac{dx}{x^{\text{M}}(f+gx)\sqrt{(a+bx)}}=\frac{dx}{x^{\text{M}}y\sqrt{z}}$

325. $\frac{dx}{x(f+gx)\sqrt{(a+bx)}}=\frac{1}{f}\int\frac{dx}{x\sqrt{z}}-\frac{g}{f}\int\frac{dx}{y\sqrt{z}}$

326. $\frac{dx}{x^2(f+gx)\sqrt{(a+bx)}}=\frac{1}{f}\int\frac{dx}{x^2\sqrt{z}}-\frac{g}{f^2}\int\frac{dx}{x\sqrt{z}}+\frac{g^2}{f^2}\int\frac{dx}{y\sqrt{z}}$

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327. $$\frac{dx}{x^3(f+gx)\sqrt{(a+bx)}}=\frac{1}{f}\int\frac{dx}{x^3\sqrt{z}}-\frac{g}{f^2}\int\frac{dx}{x^2\sqrt{z}}+\frac{g^2}{f^3}\int\frac{dx}{x\sqrt{z}}-\frac{g^3}{f^3}\int\frac{dx}{y\sqrt{x}}$$

K. $x^m(f+gx)^{-1}(a+bx^2)^{-\frac{1}{2}}dx$

a. $$\frac{x^M dx}{(f+gx)\sqrt{(a+bx^2)}}=\frac{x^M dx}{y\sqrt{z}}$$

328. $$\int\frac{xdx}{(f+gx)\sqrt{(a+bx^2)}}=\pm\frac{1}{\sqrt{(ag^2+bf^2)}}\,\text{hl}\,\frac{ag-bfx\mp\sqrt{(ag^2+bf^2)}\sqrt{z}}{y}$$
$$=\frac{1}{\sqrt{-(ag^2+bf^2)}}\text{ arc tang }\frac{ag-bfx}{\sqrt{-(ag^2+bf^2)}\sqrt{z}}$$

329. $$\int\frac{xdx}{(f+gx)\sqrt{(a+bx^2)}}=\frac{1}{g}\int\frac{dx}{\sqrt{z}}-\frac{f}{g}\int\frac{dx}{y\sqrt{z}}$$

330. $$\int\frac{x^2dx}{(f+gx)\sqrt{(a+bx^2)}}=\frac{1}{g}\int\frac{xdx}{\sqrt{z}}-\frac{f}{g^2}\int\frac{dx}{\sqrt{z}}+\frac{f^2}{g^2}\int\frac{dx}{y\sqrt{z}}$$

331. $$\int\frac{x^3dx}{(f+gx)\sqrt{(a+bx^2)}}=\frac{1}{g}\int\frac{x^2dx}{\sqrt{z}}-\frac{f}{g^2}\int\frac{xdx}{\sqrt{z}}+\frac{f^2}{g^2}\int\frac{dx}{\sqrt{z}}-\frac{f^3}{g^3}\int\frac{dx}{y\sqrt{z}}$$

b. $$\frac{dx}{x^M(f+gx)\sqrt{(a+bx^2)}}=\frac{dx}{x^M y\sqrt{z}}$$

332. $$\int\frac{dx}{x(f+gx)\sqrt{(a+bx^2)}}=\frac{1}{f}\int\frac{dx}{x\sqrt{z}}-\frac{g}{f}\int\frac{dx}{y\sqrt{z}}$$

333. $$\int\frac{dx}{x^2(f+gx)\sqrt{(a+bx^2)}}=\frac{1}{f}\int\frac{dx}{x^2+z}-\frac{g}{f^2}\int\frac{dx}{x\sqrt{z}}++\frac{g^2}{f^2}\int\frac{dx}{y\sqrt{z}}$$

334. $$\int\frac{dx}{x^3(f+gx)\sqrt{(a+bx^2)}}=\frac{1}{f}\int\frac{dx}{x^3\sqrt{z}}-\frac{g}{f^2}\int\frac{dx}{x^2\sqrt{z}}+\frac{g^2}{f^3}\int\frac{dx}{x\sqrt{z}}-\frac{g^2}{f^3}\int\frac{dx}{y\sqrt{z}}$$

L. $x^M(f+gx^2)^{-1}(a+bx^2)^{-\frac{1}{2}}dx=x^M y^{-1}z^{-\frac{1}{2}}dx$

335. $$\int\frac{dx}{(f+gx^2)\sqrt{(a+bx^2)}}=\frac{1}{\sqrt{(bf^2-afg)}}\,\text{hl}\,\frac{f\sqrt{z}+x\sqrt{(bf^2-afg)}}{\sqrt{y}}$$
$$=\frac{1}{\sqrt{(afg-bf^2)}}\text{ arc tang }\frac{x\sqrt{(afg-bf^2)}}{f\sqrt{z}}$$

336. $$\int\frac{xdx}{(f+gx^2)\sqrt{(a+bx^2)}}=\frac{1}{\sqrt{(ag^2-bfg)}}\,\text{hl}\,\frac{g\sqrt{z}-\sqrt{(ag^2-bfg)}}{\sqrt{y}}$$

$$=\frac{1}{\sqrt{(bfg-ag^2)}}\text{ arc tang }\frac{g\sqrt{z}}{\sqrt{(bfg-ag^2)}}$$

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337. $$\int\frac{x^2dx}{(f+gx^2)\sqrt{(a+bx^2)}}=\frac{1}{g}\int\frac{dx}{\sqrt{z}}-\frac{f}{g}\int\frac{dx}{y\sqrt{z}}$$

338. $$\int\frac{x^3dx}{(f+gx^2)\sqrt{(a+bx^2)}}=\frac{1}{g}\int\frac{xdx}{\sqrt{z}}-\frac{f}{g}\int\frac{xdx}{y\sqrt{z}}$$

M. $x^M(f+gx^2)^{-1}(a+bx^2)^{\frac{1}{2}}dx=x^M y^{-1}z^{\frac{1}{2}}dx$

339. $$\int\frac{\sqrt{(a+bx^2)}dx}{f+gx^2}=\frac{b}{g}\int\frac{dx}{\sqrt{z}}+\left(a-\frac{bf}{g}\right)\int\frac{dx}{y\sqrt{z}}$$

340. $$\int\frac{x\sqrt{(a+bx^2)}dx}{f+gx^2}=\frac{b}{g}\int\frac{xdx}{\sqrt{z}}+\left(a-\frac{bf}{g}\right)\int\frac{xdx}{y\sqrt{z}}$$

341. $$\int\frac{x^2\sqrt{(a+bx^2)}dx}{f+gx^2}=\frac{b}{g}\int\frac{x^2dx}{\sqrt{z}}+\left(\frac{a}{g}-\frac{bf}{g^2}\right)\int\frac{dx}{\sqrt{z}}-\left(\frac{af}{g}-\frac{bf^2}{g^2}\right)\int\frac{dx}{y\sqrt{z}}$$

342. $$\int\frac{x^3\sqrt{(a+bx^2)}dx}{f+gx^2}=\frac{b}{g}\int\frac{x^3dx}{\sqrt{z}}\surd\left(\frac{a}{g}-\frac{bf}{g^2}\right)\int\frac{xdx}{\sqrt{z}}-\left(\frac{af}{g}-\frac{bf^2}{g^2}\right)\int\frac{xdx}{y\sqrt{z}}$$

N. $x^M(f+gx)^{-1}(a+bx+cx^2)^{-\frac{1}{2}}dx=x^M y^{-1}z^{-\frac{1}{2}}dx$

Putting $ag^2-bfg+cf^2=k$

343. $$\int\frac{dx}{(f+gx)\sqrt{(a+bx+cx^2)}}=\pm\frac{1}{\sqrt{k}}\,\text{hl}\,\frac{2ag-bf+(bg-2cf)x\mp2\sqrt{k}\sqrt{z}}{y}$$
$$=\frac{1}{\sqrt{-k}}\text{ arc tang }\frac{2ag-bf+(bg-2cf)x}{2\sqrt{-k}\sqrt{y}}$$

344. $$\int\frac{xdx}{(f+gx)\sqrt{(a+bx+cx^2)}}=\frac{1}{g}\int\frac{dx}{\sqrt{z}}-\frac{f}{g}\int\frac{dx}{y\sqrt{z}}$$

345. $$\int\frac{x^2dx}{(f+gx)\sqrt{(a+bx+cx^2)}}=\frac{1}{g}\int\frac{xdx}{\sqrt{z}}-\frac{f}{g^2}\int\frac{dx}{\sqrt{z}}+\frac{f^2}{g^2}\int\frac{dx}{y\sqrt{z}}$$

346. $$\int\frac{x^3dx}{(f+gx)\sqrt{(a+bx+cx^2)}}=\frac{1}{g}\int\frac{x^2dx}{\sqrt{z}}-\frac{f}{g^2}\int\frac{xdx}{\sqrt{z}}+\frac{f^2}{g^2}\int\frac{dx}{\sqrt{z}}-\frac{f^3}{g^3}\int\frac{dx}{y\sqrt{z}}$$

O. $(a^4-x^4)^{\pm\frac{1}{2}}dx$.

Particular values, from $x=0$ to $x=a$.

347. $$\int'\frac{dx}{\sqrt{(a^4-x^4)}}=\frac{3.14159}{2a}\left(1-\left(\frac{1}{2}\right)^2+\left(\frac{1.3}{2.4}\right)^2-\left(\frac{1.3.5}{2.4.6}\right)^2+\dots\right)$$

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348. $\int' \sqrt{(a^4-x^4)}\, dx = \frac{3.14159\, a^3}{4}\left(1+\frac{1}{2}.\frac{1}{4}-\frac{1.1}{2.4}.\frac{1.3}{4.6}+\frac{1.1.3}{2.4.6}.\frac{1.3.5}{4.6.8}.-\ldots\right)$

P. $x^{M}(1-x^{2N})^{-\frac{1}{2}}dx$

Relation of particular values, from $x=0$ to $x=1$

349. $\int' \frac{x^{M}dx}{\sqrt{(1-x^{2N})}} \times \int' \frac{x^{M+N}dx}{\sqrt{(1-x^{2N})}} = \frac{3.14159}{2N(M+1)}$

Q. $x^{M}\left(1-x^{M+N}\right)^{-\frac{M+1}{M+N}}dx$

Particular value, from $x=0$ to $x=1$

350. $\int' x^{M}\left(1-x^{M+N}\right)^{-\frac{M+1}{M+N}}dx = \frac{3.14159}{M+N}$ cosec $\frac{M+1}{M+N}\,180^0$

Section V.—*Circular Fluxions.*

A. $\sin.^{M}\varphi d\varphi$

351. $\int \sin\varphi d\varphi = -\cos.\varphi$

352. $\int \sin^2\varphi d\varphi = -\frac{1}{2}\sin\varphi\cos\varphi+\frac{1}{2}\varphi$

$= -\frac{1}{4}\sin^2\varphi+\frac{1}{2}\varphi$

353. $\int \sin^3\varphi d\varphi = \left(-\frac{1}{3}\sin^2\varphi-\frac{2}{3}\right)\cos\varphi$

$= \frac{1}{12}\cos^3\varphi-\frac{3}{4}\cos\varphi$

354. $\int \sin^4\varphi d\varphi = \left(-\frac{1}{4}\sin^3\varphi-\frac{3}{8}\sin\varphi\right)\cos\varphi+\frac{3}{8}\varphi$

$= \frac{1}{32}\sin 4\varphi-\frac{1}{4}\sin 2\varphi+\frac{3}{8}\varphi$

355. $\int \sin^5\varphi d\varphi = \left(-\frac{1}{5}\sin^4\varphi-\frac{4}{15}\sin^2\varphi-\frac{8}{15}\right)\cos\varphi$

$= -\frac{1}{80}\cos 5\varphi+\frac{5}{48}\cos 3\varphi-\frac{5}{8}\cos\varphi$

356. $\int \sin^6\varphi d\varphi = \left(-\frac{1}{6}\sin^5\varphi-\frac{5}{24}\sin^3\varphi-\frac{5}{16}\sin\varphi\right)\cos\varphi+\frac{5}{16}\varphi$

$= -\frac{1}{192}\sin 6\varphi+\frac{3}{64}\sin 4\varphi-\frac{15}{64}\sin 2\varphi+\frac{5}{16}\varphi$

B. $\cos^{M}\varphi d\varphi$

357. $\int \cos\varphi d\varphi = \sin\varphi$

358. $\int \cos^2\varphi d\varphi = \frac{1}{2}\sin\varphi\cos\varphi+\frac{1}{2}\varphi$

$= \frac{1}{4}\sin 2\varphi+\frac{1}{2}\varphi$

359. $\int \cos^3\varphi\, d\varphi = \left(\frac{1}{3}\cos^2\varphi+\frac{2}{3}\right)\sin\varphi$

$= \frac{1}{12}\sin 3\varphi+\frac{3}{4}\sin\varphi$

360. $\int \cos^4\varphi\, d\varphi = \left(\frac{1}{4}\cos^3\varphi+\frac{3}{8}\cos\varphi\right)\sin\varphi+\frac{3}{8}$

$= \frac{1}{32}\sin 4\varphi+\frac{1}{4}\sin 2\varphi+\frac{3}{8}\varphi$

361. $\int \cos^5\varphi\, d\varphi = \left(\frac{1}{5}\cos^4\varphi+\frac{4}{15}\cos^2\varphi+\frac{8}{15}\right)\sin\varphi$

$= \frac{1}{80}\sin 5\varphi+\frac{5}{48}\sin 3\varphi+\frac{5}{8}\sin\varphi$

362. $\int \cos^6\varphi\, d\varphi = \left(\frac{1}{6}\cos^5\varphi+\frac{5}{24}\cos\varphi+\frac{5}{16}\cos\varphi\right)\sin\varphi+\frac{5}{16}\varphi$

$= \frac{1}{192}\sin^6\varphi+\frac{3}{64}\sin^4\varphi+\frac{15}{64}\sin^2\varphi+\frac{5}{16}\varphi$

C. $\sin^{m}\varphi\cos^{N}\varphi\, d\varphi$

a. $\sin\varphi\cos^{N}\varphi\, d\varphi$

363. $\int \sin\varphi\cos^{N}\varphi\, d\varphi = -\frac{1}{N+1}\cos^{N+1}\varphi$

It may be remarked that $\cos^{N}\varphi = \frac{1}{2^{N-1}}\left(\cos N\varphi + N\cos(N-2)\varphi + N\frac{N-1}{2}\cos(N-4)\varphi + \ldots\right]$; continuing the series through all positive angles, and putting $\frac{1}{2}$ instead of cos 0.

b. $\sin^{N}\varphi\cos\varphi\, d\varphi$

364. $\int \sin^{N}\varphi\cos\varphi\, d\varphi = \frac{1}{N+1}\sin^{N+1}\varphi$

We have for the powers of $\sin\varphi$, $\sin^{N}\varphi = \pm\frac{1}{2^{N-1}}\left(\cos N\varphi - N\cos(N-2)\varphi + N.\frac{N-1}{2}\cos(N-4)\varphi - \ldots\right)$; $+$ when $N=4P$, $-$ when $N=4P+2$; and $\sin^{N}\varphi = \pm\frac{1}{2^{N-1}}\Big(\sin N\varphi$

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$-N\sin(N-2)\varphi+N.\frac{N-1}{2}\sin(N-4)\varphi-\ldots\Big)$, $+$ when $N=4P+1$, and $-$ when $N=4P+3$; the last term, when it becomes cos 0, being altered to $\frac{1}{2}$.

c. $\sin^2\varphi\cos^N\varphi\, d\varphi$

365. $\int\sin^2\varphi\cos\varphi\, d\varphi=\frac{1}{3}\sin^3\varphi$
$$=-\frac{1}{4}\left(\frac{1}{3}\sin 3\varphi-\sin\varphi\right)$$

366. $\int\sin^2\varphi\cos^2\varphi\, d\varphi=\frac{1}{4}\sin^3\varphi\cos\varphi-\frac{1}{8}\sin\varphi\cos\varphi+\frac{1}{8}\varphi$
$$=-\frac{1}{8}\left(\frac{1}{4}\sin 4\varphi-\varphi\right)$$

367. $\int\sin^2\varphi\cos^2\varphi\, d\varphi=\left(\frac{1}{5}\cos^2\varphi+\frac{2}{15}\right)\sin^3\varphi$
$$=-\frac{1}{16}\left(\frac{1}{5}\sin 5\varphi+\frac{1}{3}\sin 3\varphi-2\sin\varphi\right)$$

368. $\int\sin^2\varphi\cos^4\varphi\, d\varphi=\frac{1}{6}\sin^3\varphi\cos^3\varphi+\frac{1}{2}\int\sin^2\varphi\cos^2\varphi\, d\varphi$
$$=-\frac{1}{32}\left(\frac{1}{6}\sin 6\varphi+\frac{1}{2}\sin 4\varphi-\frac{1}{2}\sin 2\varphi-2\varphi\right)$$

369. $\int\sin^2\varphi\cos^5\varphi\, d\varphi=\left(\frac{1}{7}\cos^4\varphi+\frac{4}{35}\cos^2\varphi+\frac{8}{105}\right)\sin^3\varphi$
$$=-\frac{1}{64}\left(\frac{1}{7}\sin 7\varphi+\frac{3}{5}\sin 5\varphi+\frac{1}{3}\sin 3\varphi-5\sin\varphi\right)$$

370. $\int\sin^2\varphi\cos^6\varphi\, d\varphi=-\frac{1}{128}\left(\frac{1}{8}\sin 8\varphi+\frac{2}{3}\sin 6\varphi+\sin 4\varphi-2\sin 2\varphi-5\varphi\right)$

d. $\sin^3\varphi\cos^N\varphi\, d\varphi$

371. $\int\sin^3\varphi\cos\varphi\, d\varphi=\frac{1}{4}\sin^4\varphi$
$$=\frac{1}{8}\left(\frac{1}{4}\cos 4\varphi-\cos 2\varphi\right)$$

372. $\int\sin^3\varphi\cos^2\varphi\, d\varphi=\left(\frac{1}{5}\sin^4\varphi-\frac{1}{15}\sin^2\varphi-\frac{2}{15}\right)\cos\varphi$
$$=\frac{1}{16}\left(\frac{1}{5}\cos 5\varphi-\frac{1}{3}\cos 3\varphi-2\cos\varphi\right)$$

373. $\int\sin^3\varphi\cos^3\varphi\, d\varphi=\left(\frac{1}{6}\cos^2\varphi+\frac{1}{12}\right)\sin^4\varphi$
$$=\frac{1}{32}\left(\frac{1}{6}\cos 6\varphi-\frac{3}{2}\cos 2\varphi\right)$$

374. $\int\sin^3\varphi\cos^4\varphi\, d\varphi=\frac{1}{7}\sin^4\varphi\cos^3\varphi-\frac{3}{7}\int\sin^3\varphi\cos^2\varphi\, d\varphi$
$$=\frac{1}{64}\left(\frac{1}{7}\cos 7\varphi+\frac{1}{5}\cos 5\varphi-\cos^3\varphi-3\cos\varphi\right)$$

375. $\int\sin^3\varphi\cos^5\varphi\, d\varphi=\frac{1}{128}\left(\frac{1}{8}\cos 8\varphi+\frac{1}{3}\cos 6\varphi-\frac{1}{2}\cos 4\varphi-3\cos 2\varphi\right)$

376. $\int\sin^3\varphi\cos^6\varphi\, d\varphi=\frac{1}{256}\left(\frac{1}{9}\cos 9\varphi+\frac{3}{7}\cos 7\varphi-\frac{8}{3}\cos 3\varphi-6\cos\varphi\right)$

e. $\sin^4\varphi\cos^N\varphi\, d\varphi$

377. $\int\sin^4\varphi\cos\varphi\, d\varphi=\frac{1}{5}\sin 5\varphi$
$$=\frac{1}{16}\left(\frac{1}{5}\sin 5\varphi-\sin 3\varphi+2\sin\varphi\right)$$

378. $\int\sin^4\varphi\cos^2\varphi\, d\varphi=\left(\frac{1}{6}\sin^5\varphi-\frac{1}{24}\sin^3\varphi-\frac{1}{16}\sin\varphi\right)\cos\varphi+\frac{1}{16}\varphi$
$$=\frac{1}{32}\left(\frac{1}{6}\sin 6\varphi-\frac{1}{2}\sin 4\varphi-\frac{1}{2}\sin 2\varphi+2\varphi\right)$$

379. $\int\sin^4\varphi\cos^3\varphi\, d\varphi=\left(\frac{1}{7}\cos^2\varphi+\frac{2}{35}\right)\sin 5\varphi$
$$=\frac{1}{64}\left(\frac{1}{7}\sin 7\varphi-\frac{1}{5}\sin 5\varphi-\sin 3\varphi+3\sin\varphi\right)$$

380. $\int\sin^4\varphi\cos^4\varphi\, d\varphi=\frac{1}{128}\left(\frac{1}{8}\sin 8\varphi-\sin 4\varphi+3\varphi\right)$

381. $\int\sin^4\varphi\cos^5\varphi\, d\varphi=\frac{1}{256}\left(\frac{1}{9}\sin 9\varphi+\frac{1}{7}\sin 7\varphi-\frac{4}{5}\sin 5\varphi-\frac{4}{3}\sin 3\varphi+6\sin\varphi\right)$

382. $\int\sin^4\varphi\cos^6\varphi\, d\varphi=\frac{1}{512}\left(\frac{1}{10}\sin 10\varphi+\frac{1}{4}\sin 8\varphi-\frac{1}{2}\sin 6\varphi-2\sin 4\varphi+\sin 2\varphi+6\varphi\right)$

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f. $\sin^5\varphi \cos^N\varphi d\varphi$

383. $\int \sin^5\varphi \cos\varphi d\varphi = \frac{1}{6}\sin^6\varphi$

$= -\frac{1}{32}\left(\frac{1}{6}\cos 6\varphi - \cos 4\varphi + \frac{5}{2}\cos 2\varphi\right)$

384. $\int \sin^5\varphi \cos^2\varphi d\varphi = \frac{1}{7}\sin^6\varphi \cos\varphi + \frac{1}{7}\int \sin^5\varphi d\varphi$

$= -\frac{1}{64}\left(\frac{1}{7}\cos 7\varphi - \frac{3}{5}\cos 5\varphi + \frac{1}{3}\cos 3\varphi + 5\cos\varphi\right)$

385. $\int \sin^5\varphi \cos^3\varphi d\varphi = \left(\frac{1}{8}\cos^2\varphi + \frac{1}{24}\right)\sin^6\varphi$

$= -\frac{1}{128}\left(\frac{1}{8}\cos 8\varphi - \frac{1}{3}\cos 6\varphi - \frac{1}{2}\cos 4\varphi + 3\cos 2\varphi\right)$

386. $\int \sin^5\varphi \cos^4\varphi d\varphi = -\frac{1}{256}\left(\frac{1}{9}\cos 9\varphi - \frac{1}{7}\cos 7\varphi - \frac{4}{5}\cos 5\varphi + \frac{4}{3}\cos 3\varphi + 6\cos\varphi\right)$

387. $\int \sin^5\varphi \cos^5\varphi d\varphi + = -\frac{1}{512}\left(\frac{1}{10}\cos 10\varphi - \frac{5}{6}\cos 6\varphi + 5\cos 2\varphi\right)$

388. $\int \sin^5\varphi \cos^6\varphi d\varphi = -\frac{1}{1024}\left(\frac{1}{11}\cos 11\varphi + \frac{1}{9}\cos 9\varphi - \frac{5}{7}\cos 7\varphi - \cos 5\varphi + \frac{10}{3}\cos 3\varphi + 10\cos\varphi\right)$

g. $\sin^6\varphi \cos^N\varphi d\varphi$

389. $\int \sin^6\varphi \cos\varphi d\varphi = \frac{1}{7}\sin 7\varphi$

$= \frac{1}{64}\left(\frac{1}{7}\sin 7\varphi - \sin 5\varphi + 3\sin 3\varphi - 5\sin 5\varphi\right)$

390. $\int \sin^6\varphi \cos^2\varphi d\varphi = \left(\frac{1}{8}\sin^7\varphi - \frac{1}{48}\sin^5\varphi - \frac{5}{192}\sin^3\varphi - \frac{5}{128}\sin\varphi\right)\cos\varphi + \frac{5}{128}\varphi$

$= -\frac{1}{128}\left(\frac{1}{8}\sin 8\varphi - \frac{2}{3}\sin 6\varphi + \sin 4\varphi + 2\sin 2\varphi - 5\varphi\right)$

391. $\int \sin^6\varphi \cos^3\varphi d\varphi = \left(\frac{1}{9}\cos^2\varphi + \frac{2}{63}\right)\sin 7\varphi$

$= -\frac{1}{256}\left(\frac{1}{9}\sin 9\varphi - \frac{3}{7}\sin 7\varphi + \frac{3}{8}\sin 3\varphi - 6\sin\varphi\right)$

392. $\int \sin^6\varphi \cos^4\varphi d\varphi = -\frac{1}{512}\left(\frac{1}{10}\sin 10\varphi - \frac{1}{4}\sin 8\varphi - \frac{1}{2}\sin 6\varphi + 2\sin 4\varphi + \sin 2\varphi - 6\varphi\right)$

393. $\int \sin^6\varphi \cos^5\varphi d\varphi = -\frac{1}{1024}\left(\frac{1}{11}\sin 11\varphi - \frac{1}{9}\sin 9\varphi - \frac{5}{7}\sin 7\varphi + \sin 5\varphi + \frac{10}{3}\sin 3\varphi - 10\sin\varphi\right)$

394. $\int \sin^6\varphi \cos^6\varphi d\varphi = -\frac{1}{2048}\left(\frac{1}{12}\sin 12\varphi - \frac{3}{4}\sin 8\varphi + \frac{15}{4}\sin 4\varphi - 10\varphi\right)$

D. $\sin^{-M}\varphi d\varphi$

395. $\int \frac{d\varphi}{\sin\varphi} = \text{hl tang}\,\frac{\varphi}{2}$

396. $\int \frac{d\varphi}{\sin^2\varphi} = -\frac{\cos\varphi}{\sin\varphi} = -\cot\varphi$

397. $\int \frac{d\varphi}{\sin^3\varphi} = -\frac{\cos\varphi}{2\sin^2\varphi} + \frac{1}{2}\,\text{hl tang}\,\frac{\varphi}{2}$

398. $\int \frac{d\varphi}{\sin^4\varphi} = \left(-\frac{1}{3\sin^3\varphi} - \frac{2}{3\sin\varphi}\right)\cos\varphi = -\cot\varphi - \frac{1}{3}\cot^3\varphi$

399. $\int \frac{d\varphi}{\sin^5\varphi} = \left(-\frac{1}{4\sin^4\varphi} - \frac{3}{8\sin^2\varphi}\right)\cos\varphi + \frac{3}{8}\,\text{hl tang}\,\frac{\varphi}{2}$

400. $\int \frac{d\varphi}{\sin^6\varphi} = \left(-\frac{1}{5\sin^5\varphi} - \frac{4}{15\sin^3\varphi} - \frac{8}{15\sin\varphi}\right)\cos\varphi$

E. $\cos^{-M}\varphi d\varphi$

401. $\int \frac{d\varphi}{\cos\varphi} = \text{hl tang}\left(45^0 + \frac{\varphi}{2}\right)$

402. $\int \frac{d\varphi}{\cos^2\varphi} = \frac{\sin\varphi}{\cos\varphi} = \text{tang}\,\varphi$

403. $\int \frac{d\varphi}{\cos^3\varphi} = \frac{\sin\varphi}{2\cos^2\varphi} + \frac{1}{2}\,\text{hl tang}\left(45^0 + \frac{\varphi}{2}\right)$

404. $\int \frac{d\varphi}{\cos^4\varphi} = \left(\frac{1}{3\cos^3\varphi} + \frac{2}{3\cos\varphi}\right)\sin\varphi = \text{tang}\,\varphi + \frac{1}{3}\text{tang}^3\varphi$

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405. $\int \frac{d\varphi}{\cos^5\varphi} = \left(\frac{1}{4\cos^4\varphi}+\frac{3}{8\cos^2\varphi}\right)\sin\varphi + \frac{3}{8}\,\text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

406. $\int \frac{d\varphi}{\cos^6\varphi} = \left(\frac{1}{5\cos^5\varphi}+\frac{4}{15\cos^3\varphi}+\frac{8}{15\cos\varphi}\right)\sin\varphi$

F. $\sin^M\varphi\cos^{-N}\varphi d\varphi$

a. $\sin^M\varphi\cos^{-1}\varphi d\varphi$

407. $\int \frac{\sin\varphi d\varphi}{\cos\varphi} = -\text{hl}\cos\varphi = \text{hl}\sec\varphi$

408. $\int \frac{\sin^2\varphi d\varphi}{\cos\varphi} = -\sin\varphi + \text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

409. $\int \frac{\sin^3\varphi d\varphi}{\cos\varphi} = -\frac{\sin^2\varphi}{2} - \text{hl}\cos\varphi$

410. $\int \frac{\sin^4\varphi d\varphi}{\cos\varphi} = -\frac{\sin^3\varphi}{3} - \sin\varphi + \text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

411. $\int \frac{\sin^5\varphi d\varphi}{\cos\varphi} = -\frac{\sin^4\varphi}{4} - \frac{\sin^2\varphi}{2} - \text{hl}\cos\varphi$

412. $\int \frac{\sin^6\varphi d\varphi}{\cos\varphi} = -\frac{\sin^5\varphi}{5} - \frac{\sin^3\varphi}{3} - \sin\varphi + \text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

b. $\sin^M\varphi\cos^{-2}\varphi d\varphi$

413. $\int \frac{\sin\varphi d\varphi}{\cos^2\varphi} = \frac{1}{\cos\varphi} = \sec\varphi$

414. $\int \frac{\sin^2\varphi d\varphi}{\cos^2\varphi} = \frac{\sin\varphi}{\cos\varphi} - \varphi = \text{tang}\,\varphi - \varphi$

415. $\int \frac{\sin^3\varphi d\varphi}{\cos^2\varphi} = \left(-\sin^2\varphi+2\right)\frac{1}{\cos\varphi} = \cos\varphi + \sec\varphi$

416. $\int \frac{\sin^4\varphi d\varphi}{\cos^2\varphi} = \left(-\frac{1}{2}\sin^3\varphi + \frac{3}{2}\sin\varphi\right)\frac{1}{\cos\varphi} - \frac{3}{2}\varphi$

417. $\int \frac{\sin^5\varphi d\varphi}{\cos^2\varphi} = \left(-\frac{1}{3}\sin^4\varphi - \frac{4}{3}\sin^2\varphi + \frac{8}{3}\right)\frac{1}{\cos\varphi}$

418. $\int \frac{\sin^6\varphi d\varphi}{\cos^2\varphi} = \left(-\frac{1}{4}\sin^5\varphi - \frac{5}{8}\sin^3\varphi + \frac{15}{8}\sin\varphi\right)\frac{1}{\cos\varphi} - \frac{15}{8}\varphi$

c. $\sin^M\varphi\cos^{-3}\varphi d\varphi$

419. $\int \frac{\sin\varphi d\varphi}{\cos^3\varphi} = \frac{1}{2\cos^2\varphi}$

420. $\int \frac{\sin^2\varphi d\varphi}{\cos^3\varphi} = \frac{\sin\varphi}{2\cos^2\varphi} - \frac{1}{2}\,\text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

421. $\int \frac{\sin^3\varphi d\varphi}{\cos^3\varphi} = \frac{1}{2\cos^2\varphi} + \text{hl}\cos\varphi$

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422. $\int \frac{\sin^4\varphi d\varphi}{\cos^3\varphi} = \left(-\sin^3\varphi + \frac{3}{2}\sin\varphi\right)\frac{1}{\cos^2\varphi} - \frac{3}{2}\,\text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

423. $\int \frac{\sin^5\varphi d\varphi}{\cos^3\varphi} = \left(-\frac{1}{2}\sin^4\varphi + 1\right)\frac{1}{\cos^2\varphi} + 2\,\text{hl}\cos\varphi$

424. $\int \frac{\sin^6\varphi d\varphi}{\cos^3\varphi} = \left(-\frac{1}{3}\sin^5\varphi - \frac{5}{3}\sin^3\varphi + \frac{5}{2}\sin\varphi\right)\frac{1}{\cos^2\varphi} - \frac{5}{2}\,\text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

d. $\sin^M\varphi\cos^{-4}\varphi d\varphi$.

425. $\int \frac{\sin\varphi d\varphi}{\cos^4\varphi} = \frac{1}{3\cos^3\varphi}$

426. $\int \frac{\sin^2\varphi d\varphi}{\cos^4\varphi} = \frac{\sin^3\varphi}{3\cos^3\varphi} = \frac{1}{3}\,\text{tang}^3\varphi$

427. $\int \frac{\sin^3\varphi d\varphi}{\cos^4\varphi} = \left(\sin^2\varphi - \frac{2}{3}\right)\frac{1}{\cos^3\varphi}$

428. $\int \frac{\sin^4\varphi d\varphi}{\cos^4\varphi} = \left(\frac{4}{3}\sin^3\varphi - \sin\varphi\right)\frac{1}{\cos^3\varphi} + \varphi = \frac{1}{3}\,\text{tang}^3\varphi - \text{tang}\,\varphi + \varphi$

429. $\int \frac{\sin^5\varphi d\varphi}{\cos^4\varphi} = \left(-\sin^4\varphi + 4\sin^2\varphi - \frac{8}{3}\right)\frac{1}{\cos^3\varphi}$

430. $\int \frac{\sin^6\varphi d\varphi}{\cos^4\varphi} = \left(-\frac{1}{2}\sin^5\varphi + \frac{10}{3}\sin^3\varphi - \frac{5}{2}\sin\varphi\right)\frac{1}{\cos^3\varphi} + \frac{5}{2}\varphi$

e. $\sin^M\varphi\cos^{-5}\varphi d\varphi$

431. $\int \frac{\sin\varphi d\varphi}{\cos^5\varphi} = \frac{1}{4\cos^4\varphi}$

432. $\int \frac{\sin^2\varphi d\varphi}{\cos^5\varphi} = \left(\frac{1}{8}\sin^3\varphi + \frac{1}{8}\sin\varphi\right)\frac{1}{\cos^4\varphi} - \frac{1}{8}\,\text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

433. $\int \frac{\sin^3\varphi d\varphi}{\cos^5\varphi} = \frac{\sin^4\varphi}{4\cos^4\varphi} = \frac{1}{4}\,\text{tang}^4\varphi$

434. $\int \frac{\sin^4\varphi d\varphi}{\cos^5\varphi} = \left(\frac{5}{8}\sin^3\varphi - \frac{3}{8}\sin\varphi\right)\frac{1}{\cos^4\varphi} + \frac{3}{8}\,\text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

435. $\int \frac{\sin^5\varphi d\varphi}{\cos^5\varphi} = \left(\frac{3}{4}\sin^4\varphi - \frac{1}{2}\sin^2\varphi\right)\frac{1}{\cos^4\varphi} - \text{hl}\cos\varphi = \frac{1}{4}\,\text{tang}^4\varphi - \frac{1}{2}\,\text{tang}^2\varphi - \text{hl}\cos\varphi$

436. $\int \frac{\sin^6\varphi d\varphi}{\cos^5\varphi} = \left(-\sin^5\varphi + \frac{25}{8}\sin^3\varphi - \frac{15}{8}\sin\varphi\right)\frac{1}{\cos^4\varphi} + \frac{15}{8}\,\text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

f. $\sin^M\varphi\cos^{-6}\varphi d\varphi$.

437. $\int\frac{\sin\varphi d\varphi}{\cos^6\varphi}=\frac{1}{5\cos^5\varphi}$

438. $\int\frac{\sin^2\varphi d\varphi}{\cos^6\varphi}=\left(-\frac{2}{15}\sin^5\varphi+\frac{1}{3}\sin^3\varphi\right)\frac{1}{\cos^5\varphi}$

439. $\int\frac{\sin^3\varphi d\varphi}{\cos^6\varphi}=\left(\frac{1}{3}\sin^2\varphi-\frac{2}{15}\right)\frac{1}{\cos^5\varphi}$

440. $\int\frac{\sin^4\varphi d\varphi}{\cos^6\varphi}=\frac{1}{5}\operatorname{tang}^5\varphi$

441. $\int\frac{\sin^5\varphi d\varphi}{\cos^6\varphi}=\left(\sin^4\varphi-\frac{4}{3}\sin^2\varphi+\frac{8}{15}\right)\frac{1}{\cos^5\varphi}$

442. $\int\frac{\sin^6\varphi d\varphi}{\cos^6\varphi}=\frac{1}{5}\operatorname{tang}^5\varphi-\frac{1}{3}\operatorname{tang}^3\varphi+\operatorname{tang}\varphi-\varphi$

G. $\sin^{-M}\varphi\cos^N\varphi d\varphi$

a. $\sin^{-1}\varphi\cos^N\varphi d\varphi$

443. $\int\frac{\cos\varphi d\varphi}{\sin\varphi}=\text{hl}\sin\varphi$

444. $\int\frac{\cos^2\varphi d\varphi}{\sin\varphi}=\cos\varphi+\text{hl}\operatorname{tang}\frac{\varphi}{2}$

445. $\int\frac{\cos^3\varphi d\varphi}{\sin\varphi}=\frac{\cos^2\varphi}{2}+\text{hl}\sin\varphi$

446. $\int\frac{\cos^4\varphi d\varphi}{\sin\varphi}=\frac{\cos^3\varphi}{3}+\cos\varphi+\text{hl}\operatorname{tang}\frac{\varphi}{2}$

447. $\int\frac{\cos^5\varphi d\varphi}{\sin\varphi}=\frac{\cos^4\varphi}{4}+\frac{\cos^2\varphi}{2}+\text{hl}\sin\varphi$

448. $\int\frac{\cos^6\varphi d\varphi}{\sin\varphi}=\frac{\cos^5\varphi}{5}+\frac{\cos^3\varphi}{3}+\cos\varphi+\text{hl}\operatorname{tang}\frac{\varphi}{2}$

b. $\sin^{-2}\varphi\cos^N\varphi d\varphi$

449. $\int\frac{\cos\varphi d\varphi}{\sin^2\varphi}=-\frac{1}{\sin\varphi}=-\operatorname{cosec}\varphi$

450. $\int\frac{\cos^2\varphi d\varphi}{\sin^2\varphi}=-\frac{\cos\varphi}{\sin\varphi}-\varphi=-\cot\varphi-\varphi$

451. $\int\frac{\cos^3\varphi d\varphi}{\sin^3\varphi}=(\cos^2\varphi-2)\frac{1}{\sin\varphi}=-\sin\varphi-$
$\operatorname{cosec}\varphi$

452. $\int\frac{\cos^4\varphi d\varphi}{\sin^2\varphi}=\left(\frac{1}{2}\cos^3\varphi-\frac{3}{2}\cos\varphi\right)\frac{1}{\sin\varphi}-\frac{3}{2}\varphi$

453. $\int\frac{\cos^5\varphi d\varphi}{\sin^2\varphi}=\left(\frac{1}{3}\cos^4\varphi+\frac{4}{3}\cos^2\varphi-\frac{8}{3}\right)\frac{1}{\sin\varphi}$

454. $\int\frac{\cos^6\varphi d\varphi}{\sin^2\varphi}=\left(\frac{1}{4}\cos^5\varphi=\frac{5}{8}\cos^3\varphi-\frac{15}{8}\cos\varphi\right)$
$\frac{1}{\sin\varphi}-\frac{15}{8}\varphi$

c. $\sin^{-3}\varphi\cos^N\varphi d\varphi$

455. $\int\frac{\cos\varphi d\varphi}{\sin^3\varphi}=-\frac{1}{2\sin^2\varphi}$

456. $\int\frac{\cos^2\varphi d\varphi}{\sin^3\varphi}=-\frac{\cos\varphi}{2\sin^2\varphi}-\frac{1}{2}\text{hl}\operatorname{tang}\frac{\varphi}{2}$

457. $\int\frac{\cos^3\varphi d\varphi}{\sin^3\varphi}=-\frac{1}{2\sin^2\varphi}-\text{hl}\sin\varphi$

458. $\int\frac{\cos^4\varphi d\varphi}{\sin^3\varphi}=\left(\cos^3\varphi-\frac{3}{2}\cos\varphi\right)\frac{1}{\sin^5\varphi}-\frac{3}{2}$
$\text{hl}\operatorname{tang}\frac{\varphi}{2}$

459. $\int\frac{\cos^5\varphi d\varphi}{\sin^3\varphi}=\left(\frac{1}{2}\cos^4\varphi-1\right)\frac{1}{\sin^2\varphi}-2\,\text{hl}\sin\varphi$

460. $\int\frac{\cos^6\varphi d\varphi}{\sin^3\varphi}=\left(\frac{1}{3}\cos^5\varphi+\frac{5}{3}\cos^3\varphi-\frac{5}{2}\cos\varphi\right)$
$\frac{1}{\sin^2\varphi}-\frac{5}{2}\text{hl}\operatorname{tang}\frac{\varphi}{2}$

d. $\sin^{-4}\varphi\cos^N\varphi d\varphi$

461. $\int\frac{\cos\varphi d\varphi}{\sin^4\varphi}=-\frac{1}{3\sin^3\varphi}$

462. $\int\frac{\cos^2\varphi d\varphi}{\sin^4\varphi}=-\frac{\cos^3\varphi}{3\sin^3\varphi}=-\frac{1}{3}\cot^3\varphi$

463. $\int\frac{\cos^3\varphi d\varphi}{\sin^4\varphi}=\left(-\cos^2\varphi+\frac{2}{3}\right)\frac{1}{\sin^3\varphi}$

464. $\int\frac{\cos^4\varphi d\varphi}{\sin^4\varphi}=\left(-\frac{4}{3}\cos^3\varphi+\cos\varphi\right)\frac{1}{\sin^3\varphi}+\varphi=$
$-\frac{1}{3}\cot^3\varphi+\cot\varphi+\varphi$

465. $\int\frac{\cos^5\varphi d\varphi}{\sin^4\varphi}=\left(\cos^4\varphi-4\cos^3\varphi+\frac{8}{3}\right)\frac{1}{\sin^3\varphi}$

466. $\int\frac{\cos^6\varphi d\varphi}{\sin^4\varphi}=\left(\frac{1}{2}\cos^5\varphi-\frac{10}{3}\cos^3\varphi+\frac{5}{2}\cos\varphi\right)$
$\frac{1}{\sin^3\varphi}+\frac{5}{2}\varphi$

e. $\sin^{-5}\varphi\cos^N\varphi d\varphi$

467. $\int\frac{\cos\varphi d\varphi}{\sin^5\varphi}=-\frac{1}{4\sin^4\varphi}$

468. $\int\frac{\cos^2\varphi d\varphi}{\sin^5\varphi}=\left(-\frac{1}{8}\cos^3\varphi-\frac{1}{8}\cos\varphi\right)\frac{1}{\sin^4\varphi}-\frac{1}{8}$
$\text{hl}\operatorname{tang}\frac{\varphi}{2}$

469. $\int\frac{\cos^3\varphi d\varphi}{\sin^5\varphi}=-\frac{\cos^4\varphi}{4\sin^4\varphi}=-\cot^4\varphi$

470. $\int\frac{\cos^4\varphi d\varphi}{\sin^5\varphi}=\left(-\frac{5}{8}\cos^3\varphi+\frac{3}{8}\cos\varphi\right)\frac{1}{\sin^4\varphi}+\frac{3}{8}$
$\text{hl}\operatorname{tang}\frac{\varphi}{2}$

471. $\int\frac{\cos^5\varphi d\varphi}{\sin^5\varphi}=\left(-\frac{3}{4}\cos^4\varphi+\frac{1}{2}\cos^2\varphi\right)\frac{1}{\sin^4\varphi}+$
$\text{hl}\sin\varphi=-\frac{1}{4}\cot^4\varphi+\frac{1}{2}\cot^2\varphi+\text{hl}\sin\varphi$

472. $\int\frac{\cos^6\varphi d\varphi}{\sin^5\varphi}=\left(\cos^5\varphi-\frac{25}{8}\cos^3\varphi+\frac{15}{8}\cos\varphi\right)$
$\frac{1}{\sin^4\varphi}+\frac{15}{8}\text{hl}\operatorname{tang}\frac{\varphi}{2}$

f. $\sin^{-6}\varphi\cos^N\varphi d\varphi$

473. $\int\frac{\cos\varphi d\varphi}{\sin^6\varphi}=-\frac{1}{5\sin^5\varphi}$

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474. $\int\frac{\cos^2\varphi d\varphi}{\sin^6\varphi}=\left(\frac{2}{15}\cos^5\varphi-\frac{1}{3}\cos^3\varphi\right)\frac{1}{\sin^5\varphi}$

475. $\int\frac{\cos^3\varphi d\varphi}{\sin^6\varphi}=\left(-\frac{1}{3}\cos^2\varphi+\frac{2}{15}\right)\frac{1}{\sin^5\varphi}$

476. $\int\frac{\cos^4\varphi d\varphi}{\sin^6\varphi}=-\frac{1}{5}\cot^5\varphi$

477. $\int\frac{\cos^5\varphi d\varphi}{\sin^6\varphi}=\left(-\cos^4\varphi+\frac{4}{3}\cos^2\varphi-\frac{8}{15}\right)\frac{1}{\sin^5\varphi}$

478. $\int\frac{\cos^6\varphi d\varphi}{\sin^6\varphi}=\left(-\frac{1}{5}\cot^5\varphi+\frac{1}{3}\cot^5\varphi-\cot\varphi-\varphi\right.$

H. $\sin^{-M}\varphi\cos^{-N}\varphi d\varphi$

a. $\sin^{-1}\varphi\cos^{-N}\varphi d\varphi$

479. $\int\frac{d\varphi}{\sin\varphi\cos\varphi}=\text{hl tang }\varphi$

480. $\int\frac{d\varphi}{\sin\varphi\cos\varphi}=\frac{1}{\cos\varphi}+\text{hl tang}\frac{\varphi}{2}$

481. $\int\frac{d\varphi}{\sin\varphi\cos^3\varphi}=\frac{1}{2\cos^2\varphi}+\text{hl tang }\varphi$

482. $\int\frac{d\varphi}{\sin\varphi\cos^4\varphi}=\frac{1}{3\cos^3\varphi}+\frac{1}{\cos\varphi}+\text{hl tang}\frac{\varphi}{2}$

483. $\int\frac{d\varphi}{\sin\varphi\cos^5\varphi}=\frac{1}{4\cos^4\varphi}+\frac{1}{2\cos^2\varphi}+\text{hl tang }\varphi$

484. $\int\frac{d\varphi}{\sin\varphi\cos^6\varphi}=\frac{1}{5\cos^5\varphi}+\frac{1}{3\cos^3\varphi}+\frac{1}{\cos\varphi}+\text{hl}$
$\text{tang}\frac{\varphi}{2}$

b. $\sin^{-2}\varphi\cos^{-N}\varphi d\varphi$

485. $\int\frac{d\varphi}{\sin^2\varphi\cos\varphi}=-\frac{1}{\sin\varphi}+\text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

486. $\int\frac{d\varphi}{\sin^2\varphi\cos^2\varphi}=-2\cot{}^2\varphi$

487. $\int\frac{d\varphi}{\sin^2\varphi\cos^3\varphi}=\left(\frac{1}{2\cos^2\varphi}-\frac{3}{2}\right)\frac{1}{\sin\varphi}+\frac{3}{2}\text{hl}$
$\text{tang}\left(45^\circ+\frac{\varphi}{2}\right)$

488. $\int\frac{d\varphi}{\sin^2\varphi\cos^4\varphi}=\frac{1}{3\sin\varphi\cos^3\varphi}-\frac{8}{3}\cot 2\varphi$

489. $\int\frac{d\varphi}{\sin^2\varphi\cos^5\varphi}=\left(\frac{1}{4\cos^4\varphi}+\frac{5}{8\cos^2\varphi}-\frac{15}{8}\right)$
$\frac{1}{\sin\varphi}+\frac{15}{8}\text{hl tang}\left(45^0+\frac{\varphi}{2}\right)$

490. $\int\frac{d\varphi}{\sin^2\varphi\cos^6\varphi}=\frac{1}{5\cos^3\varphi}+\frac{1}{5\cos^3\varphi}\Big)\frac{1}{\sin\varphi}-\frac{16}{5}$
$\cot 2\varphi$

c. $\sin^{-3}\varphi\cos^{-N}\varphi d\varphi$

491. $\int\frac{d\varphi}{\sin^3\varphi\cos\varphi}=-\frac{1}{2\sin^2\varphi}+\text{hl tang }\varphi$

492. $\int\frac{d\varphi}{\sin^3\varphi\cos^2\varphi}=\frac{1}{\sin^2\varphi\cos\varphi}-\frac{3\cos\varphi}{2\sin^2\varphi}+\frac{3}{2}\text{hl tang}\frac{\varphi}{2}$

493. $\int\frac{d\varphi}{\sin^3\varphi\cos^3\varphi}=-\frac{2\cos 2\varphi}{\sin^2 2\varphi}+2\text{hl tang }\varphi$

494. $\int\frac{d\varphi}{\sin^3\varphi\cos^4\varphi}=\left(\frac{1}{3\cos^3\varphi}+\frac{5}{3\cos\varphi}\right)\frac{1}{\sin^2\varphi}-$
$\frac{5\cos\varphi}{2\sin^2\varphi}+\frac{5}{2}\text{hl tang}\frac{\varphi}{2}$

495. $\int\frac{d\varphi}{\sin^3\varphi\cos^5\varphi}=\frac{1}{4\sin^2\varphi\cos^4\varphi}-\frac{3\cos^2 2\varphi}{\sin^2 2\varphi}+$
$3\text{ hl tang }\varphi$

496. $\int\frac{d\varphi}{\sin^3\varphi\cos^6\varphi}=\left(\frac{1}{5\cos^5\varphi}+\frac{7}{15\cos^3\varphi}+\frac{7}{3\cos\varphi}\right)$
$\frac{1}{\sin^2\varphi}-\frac{7\cos\varphi}{2\sin^2\varphi}+\frac{7}{2}\text{hl tang}\frac{\varphi}{2}$

d. $\sin^{-4}\varphi\cos^{-N}\varphi d\varphi$

497. $\int\frac{d\varphi}{\sin^4\varphi\cos\varphi}=-\frac{1}{3\sin^3\varphi}-\frac{1}{\sin\varphi}+\text{hl tang}$
$\left(45^0+\frac{\varphi}{2}\right)$

498. $\int\frac{d\varphi}{\sin^4\varphi\cos^2\varphi}=-\frac{1}{3\cos\varphi\sin^3\varphi}-\frac{8}{3}\cot 2\varphi$

499. $\int\frac{d\varphi}{\sin^4\varphi\cos^3\varphi}=\frac{1}{2\cos^2\varphi\sin^3\varphi}+\frac{5}{2}\int\frac{d\varphi}{\sin^4\varphi\cos\varphi}$

500. $\int\frac{d\varphi}{\sin^4\varphi\cos^4\varphi}=\left(-\frac{8}{3\sin^3 2\varphi}-\frac{16}{3\sin 2\varphi}\right)\cos 2\varphi$

501. $\int\frac{d\varphi}{\sin^4\varphi\cos^5\varphi}=\left(\frac{1}{4\cos^4\varphi}+\frac{7}{8\cos^2\varphi}\right)\frac{1}{\sin^3\varphi}+$
$\frac{35}{8}\int\frac{d\varphi}{\sin^4\varphi\cos\varphi}$

502. $\int\frac{d\varphi}{\sin^4\varphi\cos^6\varphi}=\frac{1}{5\cos^5\varphi\sin^3\varphi}+\frac{8}{5}\int\frac{d\varphi}{\sin^4\varphi\cos^4\varphi}$

e. $\sin^{-5}\varphi\cos^{-N}\varphi d\varphi$

503. $\int\frac{d\varphi}{\sin^5\varphi\cos\varphi}=-\frac{1}{4\sin^4\varphi}-\frac{1}{2\sin^2\varphi}+\text{hl tang }\varphi$

504. $\int\frac{d\varphi}{\sin^5\varphi\cos^2\varphi}=\left(-\frac{1}{4\sin^4\varphi}-\frac{1}{8\sin^2\varphi}+\frac{15}{8}\right)$
$\frac{1}{\cos\varphi}+\frac{15}{8}\text{ hl tang}\frac{\varphi}{2}$

505. $\int\frac{d\varphi}{\sin^5\varphi\cos^3\varphi}=-\frac{1}{4\cos^2\varphi\sin^4\varphi}-\frac{3\cos 2\varphi}{\sin^2 2\varphi}+$
$3\text{ hl tang }\varphi$

506. $\int\frac{d\varphi}{\sin^5\varphi\cos^4\varphi}=\frac{1}{3\sin^4\varphi\cos^3\varphi}+\frac{7}{3}\int\frac{d\varphi}{\sin^5\varphi\cos^2\varphi}$

507. $\int\frac{d\varphi}{\sin^5\varphi\cos^5\varphi}=\left(-\frac{4}{\sin^4 2\varphi}-\frac{6}{\sin^2 2\varphi}\right)\cos 2\varphi+$
$6\text{ hl tang }\varphi$

508. $\int\frac{d\varphi}{\sin^5\varphi\cos^6\varphi}=\left(\frac{1}{5\cos^5\varphi}+\frac{3}{5\cos^3\varphi}\right)\frac{1}{\sin^4\varphi}+\frac{21}{5}$
$\int\frac{d\varphi}{\sin^5\varphi\cos^2\varphi}$

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f. $\sin^{-6}\varphi \cos^{-N}\varphi dx$

509. $\int \frac{d\varphi}{\sin^6\varphi \cos\varphi} = -\frac{1}{5\sin^5\varphi} - \frac{1}{3\sin^3\varphi} - \frac{1}{\sin\varphi} + \text{hl tang}\left(45^0 + \frac{\varphi}{2}\right)$

510. $\int \frac{d\varphi}{\sin^6\varphi \cos^2\varphi} = \left(-\frac{1}{5\sin^5\varphi} - \frac{2}{5\sin^3\varphi}\right)\frac{1}{\cos\varphi} - \frac{16}{5}\cot 2\varphi$

511. $\int \frac{d\varphi}{\sin^6\varphi \cos^3\varphi} = \left(-\frac{1}{5\sin^5\varphi} - \frac{7}{15\sin^3\varphi} - \frac{7}{3\sin\varphi}\right)\frac{1}{\cos^2\varphi} + \frac{7\sin\varphi}{2\cos^2\varphi} + \frac{7}{2}\text{ hl tang}\left(45^0 + \frac{\varphi}{2}\right)$

512. $\int \frac{d\varphi}{\sin^6\varphi \cos^4\varphi} = -\frac{1}{5\sin^5\varphi \cos^3\varphi} - \frac{8}{5}\left(\frac{8}{3\sin^3 2\varphi} + \frac{16}{3\sin 2\varphi}\right)\cos 2\varphi$

512. $\int \frac{d\varphi}{\sin^6\varphi \cos^5\varphi} = \left(-\frac{1}{5\sin^5\varphi} - \frac{3}{5\sin^3\varphi}\right)\frac{1}{\cos^4\varphi} + \frac{21}{5}\int \frac{d\varphi}{\sin^2\varphi \cos^5\varphi}$

513. $\int \frac{d\varphi}{\sin^6\varphi \cos^6\varphi} = \left(-\frac{32}{5\sin^5 2\varphi} - \frac{128}{15\sin^3 2\varphi} - \frac{256}{15\sin 2\varphi}\right)\cos 2\varphi$

I. $\sin(a+b\varphi)\sin(c+d\varphi)d\varphi$,

514. $\int \sin(a+b\varphi)\sin(c+d\varphi)d\varphi = \frac{1}{2(b-d)}\sin(a-c+(b-d)\varphi) - \frac{1}{2(b+d)}\sin(a+c+(b+d)\varphi)$

K. $\sin(a+b\varphi)\cos(c+d\varphi)d\varphi$.

515. $\int \sin(a+b\varphi)\cos(c+d\varphi)d\varphi = -\frac{1}{2(b+d)}\cos(a+c+(b+d)\varphi) - \frac{1}{2(b-d)}\cos(a-c+(b-d)\varphi)$

L. $\cos(a+b\varphi)\cos(c+d\varphi)d\varphi$.

516. $\int \cos(a+b\varphi)\cos(c+d\varphi)d\varphi = \frac{1}{2(b+d)}\sin(a+c+(b+d)\varphi) + \frac{1}{2(b-d)}\sin(a-c+(b-d)\varphi)$

M. $\varphi^m \sin\varphi d\varphi$. For all values of m.

517. $\int \varphi^m \sin\varphi d\varphi = -\varphi^m\cos\varphi + m\varphi^{m-1}\sin\varphi + m(m-1)\varphi^{m-2}\cos\varphi - m(m-1)(m-2)\varphi^{m-3}\sin\varphi - m\,..\,(m-3)\varphi^{m-4}\cos\varphi + .. + .. - .. - .. + \ldots$

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N. $\varphi^m \cos\varphi d\varphi$.

518. $\int \varphi^m \cos\varphi d\varphi = \varphi^m \sin\varphi + m\varphi^{m-1}\cos\varphi - m(m-1)\varphi^{m-2}\sin\varphi - m(m-1)(m-2)\varphi^{m-3}\cos\varphi + .. + .. - \ldots$

O. $\varphi y dx$.

$$\int \varphi y dx = \varphi\int y dx - \int d\varphi \int y dx$$

519. $\int \varphi \sin^M\varphi d(\sin\varphi) = \frac{1}{M+1}\left(\varphi \sin^{M+1}\varphi - \int \sin^{M+1}\varphi d\varphi\right)$; or

$$\int \text{arc sin } x\,.\,x^M dx = \frac{1}{M+1}\left(\text{arc sin } x\,.\,x^{M+1} - \int \frac{x^{M+1}xd}{\sqrt{(1-x^2)}}\right)$$

520. $\int \varphi d\varphi = \frac{1}{2}\varphi^2$; or

$$\int \text{arc sin } x \frac{dx}{\sqrt{(1-x^2)}} = \frac{1}{2}(\text{arc sin } x)^2$$

$$\int \text{arc cos } x \frac{dx}{\sqrt{(1-x^2)}} = -\frac{1}{2}(\text{arc cos } x)^2$$

$$\int \text{arc tang } x \frac{dx}{1+x^2} = \frac{1}{2}(\text{arc tang } x)^2$$

$$\int \text{arc cot } x \frac{dx}{1+x^2} = -\frac{1}{2}(\text{arc cot } x)^2$$

$$\int \text{arc vsin } x \frac{dx}{\sqrt{(2x-x^2)}} = \frac{1}{2}(\text{arc vsin } x)^2$$

521. $\int \varphi \sin\varphi d\varphi = -\varphi\cos\varphi + \sin\varphi$; or

$$\int \text{arc sin } x \frac{xdx}{\sqrt{(1-x^2)}} = -\text{arc sin } x\,.\,\sqrt{(1-x^2)} + x$$

522. $\int \varphi \sin^2\varphi d\varphi = \left(-\frac{1}{2}\sin\varphi\cos\varphi + \frac{1}{4}\varphi\right)\varphi + \frac{1}{4}\sin^2\varphi$; or

$$\int \text{arc sin } x \frac{x^2dx}{\sqrt{(1-x^2)}} = \left(-\frac{1}{2}x\sqrt{(1-x^2)} + \frac{1}{4}\text{arc sin } x\right)\text{arc sin } x + \frac{1}{4}x^2$$

523. $\int \varphi \sin^3\varphi d\varphi = -\left(\frac{1}{3}\sin^2\varphi + \frac{2}{3}\right)\cos\varphi\,.\,\varphi + \frac{1}{9}\sin^3\varphi + \frac{2}{3}\sin\varphi$; or

$$\int \text{arc sin } x \frac{x^3dx}{\sqrt{(1-x^2)}} = -\left(\frac{1}{3}x^2 + \frac{2}{3}\right)\sqrt{(1-x^2)}\,.\,\text{arc sin } x + \frac{1}{9}x^3 + \frac{2}{3}x$$

524. $\int \frac{\varphi d\varphi}{\cos^2\varphi} = \frac{\varphi\sin\varphi}{\cos\varphi} + \text{hl}\cos\varphi$; or

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$$\int \text{arc sin } x \frac{dx}{(1-x^2)^{\frac{3}{2}}} = \frac{x \text{ arc sin } x}{\sqrt{(1-x^2)}} + \frac{1}{2}\text{hl}(1-x^2)$$

525. $$\int \frac{\varphi \sin \varphi d\varphi}{\cos^2 \varphi} = \frac{\varphi}{\cos \varphi} + \frac{1}{2} \text{hl} \frac{1-\sin\varphi}{1+\sin \varphi}; \text{ or}$$

$$\int \text{arc sin } x \frac{x dx}{(1-x^2)^{\frac{3}{2}}} = \frac{\text{arc sin } x}{\sqrt{(1-x^2)}} + \frac{1}{2} \text{hl} \frac{1-x}{1+x}$$

526. $$\int \varphi \cos^{M} \varphi d(\cos \varphi) = \frac{1}{M+1}\Big(\varphi \cos^{M+1}\varphi - \int \cos^{M+1}\varphi d\varphi\Big); \text{ or}$$

$$\int \text{arc cos } x \,.\, x^{M} dx = \frac{1}{M+1}\Big(\text{arc cos } x \,.\, x^{M+1} + \int \frac{x^{M+1}dx}{\sqrt{(1-x^2)}}$$

527. $$\int \varphi \,\text{tang}^{M} \varphi d(\text{tang } \varphi) = \frac{1}{M+1}\Big(\varphi\, \text{tang}^{M+1}\varphi - \int \text{tang}^{M+1}\varphi d\varphi\Big) = \frac{1}{M+1}\Big(\varphi\, \text{tang}^{M+1}\varphi - \int \frac{\sin^{M+1}\varphi d\varphi}{\cos^{M+1}\varphi}\Big); \text{ or}$$

$$\int \text{arc tang } x \,.\, x^{M} dx = \frac{1}{M+1}\Big(\text{arc tang } x \,.\, x^{M+1} - \int \frac{x^{M+1}dx}{1+x^2}\Big)$$

528. $$\int \varphi \cot^{M} \varphi d(\cot \varphi) = \frac{1}{M+1}\Big(\varphi \cot^{M+1}\varphi - \int \frac{\cos^{M+1}\varphi d\varphi}{\sin^{M+1}\varphi}\Big); \text{ or}$$

$$\int \text{arc cot } x \,.\, x^{M+1} dx = \frac{1}{M+1}\Big(\text{arc cot } x \,.\, x^{M+1} + \int \frac{x^{M+1}dx}{1+x^2}$$

529. $$\int \varphi \sec^{M} \varphi d(\sec \varphi) = \frac{1}{M+1}\Big(\varphi \sec^{M+1}\varphi - \int \frac{d\varphi}{\cos^{M+1}\varphi}\Big); \text{ or}$$

$$\int \text{arc sec } x \,.\, x^{M} dx = \frac{1}{M+1}\Big(\text{arc sec } x \,.\, x^{M+1} - \int \frac{x^{M}dx}{\sqrt{(x^2-1)}}$$

530. $$\int \varphi\, \text{cosec}^{M} \varphi d(\text{cosec } \varphi) = \frac{1}{M+1}\Big(\varphi\, \text{cosec}^{M+1}\varphi - \int \frac{d\varphi}{\sin^{M+1}\varphi}\Big); \text{ or}$$

$$\int \text{arc cosec } x \,.\, x^{M} dx = \frac{1}{M+1}\Big(\text{arc cosec } x \,.\, x^{M+1} + \int \frac{x^{M}d\varphi}{\sqrt{(x^2-1)}}$$

531. $$\int \varphi\, \text{vsin}^{M} \varphi d(\text{vsin } \varphi) = \frac{1}{M+1}\Big(\varphi\, \text{vsin}^{M+1}\varphi - \int (1-\cos \varphi)^{M+1} d\varphi; \text{ or}$$

$$\int \text{arc vsin } x \,.\, x^{M} dx = \frac{1}{M+1}\Big(\text{arc vsin } x \,.\, x^{M+1} - \int \frac{x^{M+1}dx}{\sqrt{(2x-x^2)}}\Big)$$

532. $$\int \varphi\, \text{tang}^2 \varphi d\varphi = \Big(\text{tang } \varphi - \frac{1}{2}\varphi\Big)\varphi - \text{hl sec } \varphi; \text{ or}$$

$$\int \text{arc tang } x \frac{x^2 dx}{1+x^2} = \Big(x - \frac{1}{2}\text{arc tang } x\Big) \text{arc tang } x - \frac{1}{2}\text{hl}(1+x^2)$$

533. $$\int \varphi \cos^2 \varphi d\varphi = \Big(\frac{1}{2}\text{tang } \varphi \cos^2\varphi + \frac{1}{4}\varphi\Big)\varphi + \frac{1}{4}\cos^2 \varphi; \text{ or}$$

$$\int \text{arc tang } x \frac{dx}{(1+x^2)^2} = \Big(\frac{x}{2(1+x^2)} + \frac{1}{4}\text{arc tang } x\Big) \text{arc tang } x + \frac{1}{4(1+x^2)}$$

P. $(a+b\cos\varphi)^{-M}(f+g\cos\varphi)d\varphi$

534. $$\int \frac{d\varphi}{a+b\cos\varphi} = \frac{1}{\sqrt{(a^2-b^2)}} \text{ arc cos } \frac{b+a\cos\varphi}{a+b\cos\varphi} = \frac{1}{\sqrt{(b^2-a^2)}} \text{hl} \frac{b+a\cos\varphi+\sin\varphi.\sqrt{(b^2-a^2)}}{a+b\cos\varphi};$$

or, for $a=b$

$$\int \frac{d\varphi}{a+a\cos\varphi} = \frac{1}{a}\text{ tang } \frac{1}{2}\varphi$$

535. $$\int \frac{\cos\varphi d\varphi}{a+b\cos\varphi} = \frac{\varphi}{b} - \frac{a}{b}\int \frac{d\varphi}{a+b\cos\varphi}$$

536. $$\int \frac{d\varphi}{(a+b\cos\varphi)^2} = \frac{1}{(a^2-b^2)}\Big(\frac{-b\sin\varphi}{a+b\cos\varphi} + a\int \frac{d\varphi}{a+b\cos\varphi}\Big)$$

537. $$\int \frac{\cos\varphi d\varphi}{(a+b\cos\varphi)^2} = \frac{1}{(a^2-b^2)}\Big(\frac{a\sin\varphi}{a+b\cos\varphi} - b\int \frac{d\varphi}{a+b\cos\varphi}$$

Q. $(a+b\cos\varphi)^{-1}\sin\varphi d\varphi$

538. $$\int \frac{\sin\varphi d\varphi}{a+b\cos\varphi} = -\frac{1}{b}\text{ hl }(a+b\cos\varphi)$$

R. $(1+a\cos\varphi)^{M}d\varphi$. For fractional powers see Méc. Cél.; also Ivory and Wallace, *Ed. Trans.* 1798, 1805.

539. $$\int (1+a\cos\varphi)d\varphi = \varphi + a\sin\varphi$$

540. $$\int (1+a\cos\varphi)^2 d\varphi = \Big(1+\frac{1}{2}a^2\Big)\varphi + 2a\sin\varphi + \frac{1}{4}a^2\sin 2\varphi$$

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541. $\int (1+a\cos\varphi)^3 d\varphi = \left(1+\frac{3}{2}a^2\right)\varphi + \left(3a + \frac{3}{4}a^3\right)\sin\varphi + \frac{3}{4}a^2\sin 2\varphi + \frac{1}{12}a^3\sin 3\varphi$

542. $\int (1+a\cos\varphi)^4 d\varphi = \left(1+3a^2+\frac{3}{8}a^4\right)\varphi + (4a+3a^3)\sin\varphi + \left(\frac{3}{2}a^2+\frac{1}{4}a^4\right)\sin 2\varphi + \frac{1}{3}a^3\sin 3\varphi + \frac{1}{32}a^4\sin 4\varphi$

SECT. VI.—*Logarithmic Fluxions.*

A. $\mathrm{hl}\, x.y\mathrm{d}z$

$$\int \mathrm{hl}\, x.y\mathrm{d}z = \mathrm{hl}\, x\int y\mathrm{d}z - \int \mathrm{d}\,\mathrm{hl}\, x\int y\mathrm{d}z = \mathrm{hl}\, x\int y\mathrm{d}z - \int\frac{\mathrm{d}x}{x}\int y\mathrm{d}z$$

543. $\int x^m\,\mathrm{hl}\, x\mathrm{d}x = \frac{x^{m+1}}{m+1}\left(\mathrm{hl}\, x - \frac{1}{m+1}\right)$

544. $\int x^{-1}\mathrm{hl}\, x\mathrm{d}x = \frac{1}{2}\mathrm{hl}^2 x$

545. $\int \mathrm{hl}\,(a+bx)\frac{\mathrm{d}x}{x} = \mathrm{hl}\, a\,\mathrm{hl}\, x + \frac{bx}{a} - \frac{b^2x^2}{2^2a^2} + \frac{b^3x^3}{3^2a^3} - \ldots$

$$= \frac{1}{2}\mathrm{hl}^2 bx - \frac{a}{bx} + \frac{a^2}{2^2b^2x^2} - \frac{a^3}{3^2b^3x^3} + \ldots$$

546. $\int \frac{\mathrm{hl}\, x\mathrm{d}x}{a+bx} = \frac{1}{b}\mathrm{hl}\, x\,\mathrm{hl}\,(a+bx) - \frac{1}{b}\int\frac{\mathrm{d}x}{x}\mathrm{hl}\,(a+bx)$

$$= \frac{1}{b}\mathrm{hl}\, x\,\mathrm{hl}\frac{a+bx}{a} - \frac{x}{a} + \frac{bx^2}{2^2a^2} - \frac{b^2x^3}{3^2a^3} + \ldots$$

$$= \frac{1}{b}\mathrm{hl}\, x\,\mathrm{hl}\,(a+bx) - \frac{1}{2b}\mathrm{hl}^2 bx + \frac{a}{b^2x} - \frac{a^2}{2^2b^3x^2} + \frac{a^3}{3^2b^4x^3} - \ldots$$

B. $\mathrm{hl}^n x.y\mathrm{d}x$

Since $\int Y\mathrm{d}Z = \frac{\mathrm{d}Y}{\mathrm{d}X}\int Z\mathrm{d}X - \frac{\mathrm{d}^2Y}{\mathrm{d}X^2}\int^2 Z\mathrm{d}X^2 + \ldots$ (n5), taking the $\mathrm{d}X$ of this theorem $= \frac{\mathrm{d}x}{x}$, $Y = \mathrm{hl}^n x$ and $\mathrm{d}Z = y\mathrm{d}x$, we have

$$\int Y\mathrm{d}Z = \int \mathrm{hl}^n x.y\mathrm{d}x = \frac{\mathrm{d}Y}{\mathrm{d}X}\int\left(\int y\mathrm{d}x\right)\frac{\mathrm{d}x}{x}\ldots = \mathrm{d}\,\mathrm{hl}^n x\,\frac{x}{\mathrm{d}x}\int\left(\int y\mathrm{d}x\right)\frac{\mathrm{d}x}{x} - \ldots;$$ thus,

$y = x^m$

547. $\int x^m\,\mathrm{hl}^n x\mathrm{d}x = \frac{x^{m+1}}{m+1}\left(\mathrm{hl}^n x - \frac{n}{m+1}\mathrm{hl}^{n-1}x + \frac{n(n-1)}{(m+1)^2}\mathrm{hl}^{n-2}x - \ldots\right)$

When n is a negative whole number $= -\mathrm{N}$, we may obtain a finite series by making $Y = yx$, and $\mathrm{d}Z = \frac{\mathrm{d}x}{x}\mathrm{hl}^{-\mathrm{N}}x$, but the last term still contains a fluent.

548. $\int x^{-1}\mathrm{hl}^n x\mathrm{d}x = \int\frac{\mathrm{d}x}{x}\mathrm{hl}^n x = \frac{1}{n+1}\mathrm{hl}^{n+1}x$

549. $\int\frac{\mathrm{d}x}{\mathrm{hl}\, x} = \mathrm{hl}\,\mathrm{hl}\, x + \frac{\mathrm{hl}\, x}{1} + \frac{1}{2}\frac{\mathrm{hl}^2 x}{1.2} + \frac{1}{3}\frac{\mathrm{hl}^3 x}{1.2.3} + \ldots$

550. $\int\frac{x^m\mathrm{d}x}{\mathrm{hl}\, x} = \int\frac{\mathrm{d}y}{\mathrm{hl}\, y}$, when $y = x^{m+1}$

551. $\int\frac{x^m\mathrm{d}x}{\mathrm{hl}^2 x} = -\frac{x^{m+1}}{\mathrm{hl}\, x} + (m+1)\int\frac{x^m\mathrm{d}x}{\mathrm{hl}\, x}$

552. $\int\frac{x^m\mathrm{d}x}{\mathrm{hl}^3 x} = -\frac{x^{m+1}}{2\mathrm{hl}^2 x} - \frac{(m+1)x^{m+1}}{2.1\mathrm{hl}\, x} + \frac{(m+1)^2}{2.1}\int\frac{x^m\mathrm{d}x}{\mathrm{hl}\, x}$

553. $\int\frac{\mathrm{d}x}{\mathrm{hl}\frac{1}{x}} = \mathrm{hl}\,\mathrm{hl}\, x - \frac{\mathrm{hl}\, x}{1} + \frac{1}{2}.\frac{\mathrm{hl}^2 x}{1.2} - \frac{1}{3}.\frac{\mathrm{hl}^3 x}{1.2.3} + \ldots$

Particular values, from $x=0$ to $x=1$.

554. $\int'\frac{\mathrm{d}x}{\sqrt{\mathrm{hl}\frac{1}{x}}} = \sqrt{3.141592}$. Euler, Comm. Ac. Petr. XVI.

555. $\int'\mathrm{d}x\left(\mathrm{hl}\frac{1}{x}\right)^{\frac{2\mathrm{M}+1}{2}} = \frac{1.3.5.7..(2\mathrm{M}+1)}{2^{\mathrm{M}+1}}\sqrt{3.141592}$. Ibid.

SECT. VII.—*Exponential Fluxions.*

A. $a^x y\mathrm{d}x$

In the theorem $\int Y\mathrm{d}Z = \frac{\mathrm{d}Y}{\mathrm{d}X}\int Z\mathrm{d}Y - \ldots$ we may put either $\mathrm{d}X = \mathrm{d}x$, $Y = y$, and $\mathrm{d}Z = a^x\mathrm{d}x = \mathrm{d}\frac{a^x}{\mathrm{hl}\, a}$, or $\mathrm{d}X = \mathrm{d}x$, $Y = a^x$, and $\mathrm{d}Z = y\mathrm{d}x$; and, in the former manner, we obtain,

556. $\int a^x x^m\mathrm{d}x = \frac{a^x x^m}{\mathrm{hl}\, a} - \frac{ma^x x^{m-1}}{\mathrm{hl}^2 a} + \frac{m(m-1)a^x x^{m-2}}{\mathrm{hl}^3 a} - \ldots$; thus,

557. $\int a^x\mathrm{d}x = \frac{a^x}{\mathrm{hl}\, a}$

558. $\int a^x x\mathrm{d}x = \frac{a^x x}{\mathrm{hl}\, a} - \frac{a^x}{\mathrm{hl}^2 a}$

559. $\int a^x x^2\mathrm{d}x = \frac{a^x x^2}{\mathrm{hl}\, a} - \frac{2a^x x}{\mathrm{hl}^2 a} + \frac{2.1x^x}{\mathrm{hl}^3 a}$

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560. $\int a^x x^3 dx = \frac{a^x x^3}{\text{hl}\, a} - \frac{3a^x x^2}{\text{hl}^2 a} + \frac{3.2a^x x}{\text{hl}^3 a} - \frac{3.2.1 a^x}{\text{hl}^4 a}$.

561. $\int \frac{a^x dx}{x} = \text{hl}\, x + \frac{x\, \text{hl}\, a}{1} + \frac{x^2\, \text{hl}^2 a}{1.2.2} + \frac{x^3\, \text{hl}^3 a}{1.2.3.3} + \dots$

562. $\int \frac{a^x dx}{x^2} = -\frac{a^x}{x} + \text{hl}\, a \int \frac{a^x dx}{x}$

563. $\int \frac{a^x dx}{x^3} = -\frac{a^x}{2x^2} - \frac{a^x \text{hl}\, a}{2.1x} + \frac{\text{hl}^2 a}{2.1} \int \frac{a^x dx}{x}$

564. $\int \frac{a^x dx}{x^4} = -\frac{a^x}{3x^3} - \frac{a^x \text{hl}\, a}{3.2x^2} - \frac{a^x \text{hl}^2 a}{3.2.1} + \frac{\text{hl}^3 a}{3.2.1} \int \frac{a^x dx}{x}$

565. $\int \frac{a^x dx}{\surd x} = \frac{a^x}{\surd x}\left(\frac{1}{\text{hl}\, a} - \frac{1}{2x\, \text{hl}^2 a} + \frac{1.3}{(2x)^2\, \text{hl}^3 a} + \frac{1.3.5}{(2x)^3\, \text{hl}^4 a} + \dots\right)$

$= \frac{a^x}{\surd x}\left(\frac{2x}{1} - \frac{(2x)^2\, \text{hl}\, a}{1.3} + \frac{(2x)^3\, \text{hl}^2 a}{1.3.5} - \dots\right)$.

566. $\int \frac{a^x dx}{1-x} = a^x\left(\frac{1}{(1-x)\, \text{hl}\, a} - \frac{1}{(1-x)^2\, \text{hl}^2 a} + \frac{1.2}{(1-x)^3\, \text{hl}^3 a} - \frac{1.2.3}{(1-x)^4\, \text{hl}^4 a} + \dots\right)$

B. $a^{mx} x^n dx$

567. $\int a^{mx} x^n dx = \frac{1}{m^{n+1}} \int a^y y^n dy$; making $y = mx$

C. $x^{m+nx} dx$

568. $\int x^{m+nx} dx = \int \left(1 + \frac{nx\, \text{hl}\, x}{1} + \frac{n^2 x^2\, \text{hl}^2 x}{1.2} + \frac{n^3 x^3\, \text{hl}\, x}{1.2.3} + \dots\right) x^m dx$

Particular value, from $x=0$ to $x=1$

569. $\int' x^{\text{M}+nx} dx = \frac{1}{\text{M}+1} - \frac{n}{(\text{M}+2)^2} + \frac{n^2}{(\text{M}+3)^3} - \dots$

D. $e^{-xx} dx$

Putting, in the Taylorian theorem, $\int \text{Y} dZ = \frac{dY}{dX} \int Z dX - \dots$ (n.5) $Y = e^{-xx}$, $Z = x$, and $dX = d(-xx) = -2x dx$, we have,

570. $\int e^{-xx} dx = e^{-xx}\left(-\frac{2}{3}x^3\right) - e^{-xx} \cdot \frac{4}{3.5} x^5 + e^{-xx}\left(-\frac{8}{3.5.7}x^7\right) - \dots$

$= -e^{-xx}\left(\frac{2}{3}x^3 + \frac{4}{3.5}x^5 + \frac{8}{8.5.7}x^7 + \dots\right)$

Particular value, from $x = -\infty$ to $x = +\infty$

571. $\int' e^{-xx} dx = \surd 3.14159$, Laplace, Méc. Cél. X.; or thus,

$\int e^{-xx} dx = \int y dx$, $-xx = \text{hl}\, y$, $xx = \text{hl}\frac{1}{y}$, $x = \surd \text{hl}\frac{1}{y}$; $dy = -e^{-xx} 2x dx$; $\frac{dy}{\surd \text{hl}\frac{1}{y}} = -2e^{-xx} dx$, and

$\int e^{-xx} dx = -\frac{1}{2} \int \frac{dy}{\surd \text{hl}\frac{1}{y}}$ (n.554): in this expression we may make $\frac{1}{\surd \text{hl}\frac{1}{y}} = Y$, then $dY = \frac{d\, \text{hl}\, y}{2(\text{hl}\frac{1}{y})^{\frac{3}{2}}}$, and if we wish to have $\frac{dY}{dX} = Y$, we must take $dX = d\, \text{hl}\, y$, and Z will be $= y$, so that the series will give us $\int \frac{dy}{\surd \text{hl}\frac{1}{y}} =$

$\frac{1}{2(\text{hl}\frac{1}{y})^{\frac{3}{2}}} y - \frac{3}{4(\text{hl}\frac{1}{y})^{\frac{5}{2}}} y + \frac{3.5}{8(\text{hl}\frac{1}{y})^{\frac{7}{2}}} - \dots =$

$\frac{y}{\surd(\text{hl}\frac{1}{y})}\left(\frac{1}{2(\text{hl}\frac{1}{y})} - \frac{3}{4(\text{hl}\frac{1}{y})^2} + \frac{3.5}{8(\text{hl}\frac{1}{y})^3} - \dots\right)$; but these series will fail in the extreme cases, although they converge with sufficient rapidity in most others.

E. $\int e^{x^m} dx$

Putting $e^{x^m} = Y$, we have $dY = e^{x^m} m x^{m-1} dx$ and taking $dX = x^{m-1} dx$, and $Z = x$, we obtain the series.

572. $\int e^{x^m} dx = m e^{x^m} \frac{1}{m+1} x^{m+1}\, m^2 e^{x^m} \frac{1}{(m+1)(2m+1)} x^{2m+1} + \dots$

F. $e^{ax} \sin^{\text{M}} x dx$

573. $\int e^{ax} \sin x dx = \frac{e^{ax}(a \sin x - \cos x)}{a^2+1}$

574. $\int e^{ax} \sin^2 x dx = \frac{e^{ax} \sin x (a \sin x - 2 \cos x)}{a^2+4} + \frac{1.2 e^{ax}}{a(a^2+4)}$

575. $\int e^{ax} \sin^3 x dx = \frac{e^{ax} \sin^2 x (a \sin x - 3 \cos x)}{a^2+9} + \frac{2.3 e^{ax}(a \sin x - \cos x)}{(a^2+1)(a^2+9)}$

Fluents.

G. $e^{ax}\cos^{M}x\,dx$

576. $\int e^{ax}\cos x\,dx = \frac{e^{ax}(a\cos x+\sin x)}{a^2+1}$

577. $\int e^{ax}\cos^2 x\,dx = \frac{e^{ax}\cos x(a\cos x+2\sin x)}{a^2+4} + \frac{1.2e^{ax}}{a(a^2+4)}$

578. $\int e^{ax}\cos^3 x\,dx = \frac{e^{ax}\cos^2 x(a\cos x+3\sin x)}{a^2+9} + \frac{2.3e^{ax}(a\cos x+\sin x)}{(a^2+1)(a^2+9)}$

H. $e^{ax}\sin bx\,dx$

579. $\int e^{ax}\sin bx\,dx = \frac{e^{ax}(a\sin bx - b\cos bx)}{a^2+b^2}$

I. $e^{ax}\cos bx\,dx$

580. $\int e^{ax}\cos bx\,dx = \frac{e^{ax}(a\cos bx + b\sin bx)}{a^2+b^2}$

Sect. VIII.—*Index of Fluxions.*

Transformations. For

A. $x^{n-1}(a+bx^{2n})^{-M}dx$

B. $x^{\frac{1}{2}}(a+bx)^{\pm\frac{1}{2}}dx$

C. $x^{-\frac{1}{2}}(a+bx)^{-N}dx$

Fluents || Fluids.

We have

$$A = \frac{dy}{2(a+by^2)^{M}}; \text{ if } y = x^n$$

$$B = (ax+bx^2)^{\frac{1}{2}} dx; \text{ or}$$

$$= x(ax+bx^2)^{-\frac{1}{2}} dx$$

$$C = 2(a+by^2)^{-N} dy; \text{ if } y^2 = x$$

The Fluxions of which Mr Landen has assigned the fluents in the first volume of his *Mathematical Memoirs*, 4to, London, 1780, by means of arcs of the conic sections, are chiefly of some of the following forms:

Table III. $x^{\pm\frac{1}{2},0}(a+bx^2)^{-\frac{1}{2},\frac{1}{4},\frac{3}{4}} dx$

IV. $x^{\pm 0,\frac{1}{3},\frac{2}{3}}(a+bx^2)^{-\frac{1}{2},\frac{1}{3},\frac{2}{3}} dx$

$x^{\pm 0,\frac{1}{2},1,\frac{3}{2}}(a+bx^3)^{-\frac{1}{2},\frac{1}{3},\frac{2}{3}} dx$

XII. $x^{\pm\frac{1}{2}}(a+bx+cx^2)^{-\frac{1}{2}} dx$

$x(f+gx)^{-\frac{1}{2}}(a+bx^2)^{-\frac{1}{2}} dx$

$(f \pm (a+bx^2)^{\frac{1}{2}})^{-\frac{1}{2}} dx$

$x^{-\frac{1}{2}}(a \pm x)^{\frac{1}{2}}(b \pm x)^{-\frac{1}{2}} dx$

$x^{-\frac{1}{2}}(a+bx+cx^2)^{\frac{1}{2}}(d+ex)^{-\frac{1}{2}} dx$

$x^{\pm\frac{1}{2}}(a+bx+cx^2)^{-\frac{1}{2}}(d+ex)^{-1} dx$

$x^{-1,2,+\frac{3}{2}}(a+bx+cx^2)^{-\frac{1}{2}}(d+ex)^{-\frac{1}{2}} dx$

$x^{0,\pm 1,2}(a+bx+cx^2)^{-\frac{1}{2}}(d+ex+fx^2)^{-\frac{1}{2}}$
dx

(S. F.)

FLUIDS, Elevation of.*

Capillary Action.

1. When a solid body is partially plunged in a fluid, the level surface near it is disturbed, and the fluid is observed either to ascend or descend, so as to form a ring round the part immersed. If a tube of glass be inserted in a vessel containing water, the liquid will rise in a concave ring both on the outside and the inside; and if the tube be small enough, the cylinder of water within it will be elevated above the general level, and the elevation will be greater nearly in the same proportion that the bore is less. On the other hand, if the tube be plunged in mercury, the fluid in contact with the glass will be depressed, forming a hollow ring with the convexity upward; and when the diameter is very small, the cylinder of mercury in the inside will sink below the level on the outside. In all these appearances the physical cause is the same, and it has received the name of Capillary Action, because its effects are most remarkable in the case of tubes with extremely minute diameters.

No part of Natural Philosophy has been the subject of a greater variety of researches than Capillary Action. It has been viewed in almost every possible light, and it would be difficult to suggest a new principle that has not been proposed by some philosopher in order to account for the observed appearances. One advantage has resulted from repeated discussion; for by this means the true cause of the phenomena is no longer doubtful, although there is still considerable difference of opinion with regard to the manner in which the effects are produced. It is now universally allowed, that the suspension of fluids in capillary tubes is to be ascribed to the attraction observed to take place between the elementary particles of which bodies are composed. We shall not stop to detail the different experiments which prove the reality of this attractive force, and we shall at once assume that the two following facts, which are the fundamental principles of this theory, are fully established; namely, that glass and other solid bodies attract the particles of fluids with which they are in contact, and, that the particles of fluids attract one another. Admitting these two kinds of attraction, it remains to investigate the consequences that flow from them.

Law of Corpuscular Attraction.

2. Corpuscular attraction acts with great intensity in contact, or at the nearest distances, but it decreases very rapidly as the distance increases, and, on the whole, is confined within a very small range. Clairaut supposed that the sides of a capillary tube extend their action to the central parts of the contained cylinder of fluid. But in this opinion he is singular. All other philosophers confine the sphere of attraction within much narrower limits. They suppose that the corpuscular force has produced its full effect, and has become evanescent, at a distance so small that it cannot be appreciated by the senses. But from this, we are not to conclude that a particle attracts those only which are quite contiguous to it; its action, although confined within a sphere of a very small radius, nevertheless extends to some distance, and reaches to the particles beyond the nearest.

As corpuscular attraction extends its influence to a distance, it must vary, within the sphere of its action, according to some law, which is unknown, and in all probability will never be discovered. But a knowledge of this law is not necessary to explain the capillary phenomena; for these are caused by the accumulated action of the force in its whole range, and are independent of the intermediate va-

* The subject of this article ought, properly, to have been treated under Capillary Action; and we have thought it better to consider it in this place, than under the head of Tubes, Capillary, to which a reference was made from Capillary Action.

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riations of intensity which it may undergo. In this respect, capillary action resembles the attraction by which transparent bodies refract the rays of light. In both cases, what we observe is the total effect of the attractive energy, which may remain the same, although the intermediate degrees of intensity be infinitely varied.

Attraction of a fluid mass on its own particles.

3. Conceive a fluid mass (Plate LXXX. fig. 1), the particles of which attract one another, but which is subjected to the action of no other forces, not even to that of gravity; and let an imaginary surface be traced through the fluid, having at every part a depth equal to the utmost range of the corpuscular force. Then a particle placed within the imaginary surface may be considered as occupying the centre of a sphere of the fluid, described with a radius equal to the greatest distance to which attraction reaches; whence it is manifest that the particle will be urged with equal forces in all opposite directions. If the particle be placed between the boundaries of the superficial stratum or film, the sphere of which it is the centre will extend above the fluid's surface; and, on account of the defect of matter, the particle will be less attracted outward than inward. Let N be a particle so situated, and suppose that n is another particle as much elevated above the fluid's surface as N is immersed below it; and trace the surface PQ in the fluid as far below N as that particle itself is below the outer boundary of the fluid mass. Then the particle N will be in equilibrium with regard to the attraction of all the fluid above PQ; but it will be urged inward by the force with which it is attracted by the fluid below PQ; and as the particles at N and n are similarly situated with regard to the whole fluid mass, and the part of it below the surface PQ, it is manifest that the attraction of the whole mass upon the particle at n is equal to the force which urges the particle at N inward. From this it follows, that all particles placed in a stratum which is every where at the same depth below the fluid's surface, are drawn inward with the same force, equal to that with which the whole mass attracts a particle placed at an equal height above the fluid's surface.

If now we conceive a canal passing through the interior of the fluid, and terminating both ways in the surface, it follows, from what has been said, that the attraction of the whole mass upon the superficial drops placed at the two orifices, will propagate equal pressures in opposite directions, through the canal. In order to estimate the force of compression, we may denote, by K, the pressure inward, caused by the attraction of the whole fluid upon a square inch of the superficial film; then a portion of the fluid within the canal will be compressed by the equal forces, K, acting in opposite directions. This is true of all portions of the fluid within the superficial stratum; between the boundaries of that stratum the compressive force is less, being always of the same intensity at the same depth, but decreasing rapidly in approaching the surface, where it is evanescent.

We may now conceive a fluid mass, whatever be its figure, to consist of a central part, surrounded by an indefinite number of thin beds or strata, placed at equal depths below the surface; and it will follow, from what has been proved, that the compression is constant in all the central part; and likewise that it is uniformly of the same intensity throughout every superficial stratum, varying from one stratum to another, and decreasing very rapidly near the surface. Such a body of fluid will therefore be in equilibrium whatever be its figure; in other words, the corpuscular attraction will oppose no resistance to a change of figure in the fluid, nor obstruct, in any degree, the perfect mobility of the particles among one another.

4

It must be observed, however, that the conclusion just obtained is exact only when we confine our attention to the direct action of the attractive forces, as is done in the theory of the figure of the earth. But there is another effect caused by the direct attraction of the particles of a fluid, to be afterwards considered, which takes place only at the surface, and from which this consequence results, that a body of fluid subjected to no forces but the attraction of its own particles, will no longer be indifferent to any figure, but will arrange itself in a perfect sphere.

Effect of temperature.

A change in the temperature of a fluid mass will produce an alteration in the cohesive force; but it appears very difficult, if not impossible, to estimate, in any satisfactory manner, the effect arising from this cause.

A variation of temperature will affect the attraction of the particles of a fluid by the change of density which it induces. When two portions of a fluid attract one another, if we conceive one of them to have its density changed, while that of the other remains unaltered, it is evident that their cohesion will be proportional to the number of particles of the first portion placed within the sphere of action of the second; that is, it will vary in the direct proportion of the density. Again, if we now suppose the density of the second portion to vary, the attractive force will, on this account, also suffer a proportional change. Wherefore, when both portions undergo an equal change of temperature, their cohesion will vary as the square of the density.

Again, the variations in the mutual distances of the particles of a fluid, caused by changes of temperature, must bear a finite proportion to the range of the corpuscular force; and, on this account, a change in the fluid's cohesion will take place, depending upon the law that attraction follows in regard to the distance. At a given temperature, and under a given pressure, the particles are separated from one another to a certain distance, at which there is an equilibrium between the attractive force which impels them towards one another, and the repulsive power attending the action of heat. In these circumstances, the actual cohesion is due to that part only of the whole corpuscular force which is exerted upon the particles placed beyond the limit of approach allowed by the given degree of temperature. The cohesion, too, is diminished not only by the decreased intensity of the attractive force, but also by the increased repulsion of heat. Our ignorance of the laws that regulate the action of these forces makes it impossible to subject to calculation the effect of a change of temperature; but, when we consider that corpuscular attraction decreases very ra-

pidly as the distance increases, it is extremely probable that the cohesion of a fluid undergoes much greater changes from this cause than from the variations of density.

But capillary action arises from the cohesion between the particles of a fluid, and the attraction that takes place between them and the solid bodies with which they are brought into contact. Experiments show that these forces continue to act so long as the state of fluidity endures; their action is constant under the same temperature; and they are affected in degree only by the variations of heat. In the further prosecution of this inquiry, we shall therefore throw out of view the effect of temperature, and shall confine our attention to develope the consequences of corpuscular attraction.

Attraction between a solid body and a fluid.

4. The attraction of a solid body on every particle of a fluid within the sphere of its action, is a force perpendicular to the surface of the solid. This is manifest from the homogeneity of the solid when its surface is a plane; for, on account of the uniform arrangement of the parts, there is no reason why the attractive force should decline from the perpendicular to one side rather than to another. And when the solid is bounded by a curve of any kind, we may still consider the extremely small part of the surface which acts on a particle, as coinciding with the tangent plane; whence we may conclude that, in all cases, the attraction on every particle is perpendicular to the surface of the attracting body. The same thing is true in the action of transparent bodies on light. For, if the motion of a ray be decomposed into two parts, one parallel to the refracting surface, and the other perpendicular to it, the observed law of refraction implies, that the velocity of the first part will remain unchanged, while the velocity of the other part will be increased or diminished by the refracting force.

If a smooth plate of glass be laid horizontally upon the surface of water, it is found that the glass will adhere to the water. The adhesion is not produced by the pressure of the atmosphere, for the fact is equally true in the vacuum of an air-pump. There is, therefore, evidently an attraction between the glass and the water, acting perpendicularly to the plate, and causing it to adhere to the water.

If the plate, instead of being laid horizontally upon the water, be immersed vertically in it, the part below the surface will exert the same attractions as it did in the former position. Every particle of the fluid within the sphere of action of the glass will be drawn perpendicularly towards it, and a thin coating of the fluid will attach itself to all the immersed surface of the plate.

Secondary, or lateral, force.

5. Although the attractive force exerted by a solid body on a fluid is confined to insensible distances, it must still be considered as penetrating in some degree into the fluid mass. The thin film on which it acts retains possession of all the properties of a fluid. The particles of water in contact with the glass press upon its surface; the particles farther off press upon those nearer; and the whole film is in a state of compression. But it is a distinguishing property of a fluid, arising from the perfect mobility of its particles, that a pressure in one direction will cause an equal pressure in all directions; and hence we must infer that the thin film of water, at the same time that it is compressed by the direct attraction of the glass, will likewise press laterally, or will make an effort to spread itself towards every side on the surface of the plate. If the film, instead of being attracted by the plate, were pressed against its surface by a weight, the lateral pressure, estimated on a given superficial space, would be the same with the direct pressure. But, as the strata, at different distances from the plate, are attracted in unequal degrees, the whole lateral force can be found only by summing up the lateral pressures arising from the attraction upon each stratum.

Let AB (fig. 2.) be a plate of glass on which there stands an upright vessel, or tube, containing water; and let GH be a thin section, or elementary part of the water within the tube, parallel to the glass and so near it as to be attracted by it. Suppose that ϖ denotes the area of the section, a its distance from the plate, and da its thickness; and let $\Psi(a)$ represent the attraction of the whole matter of the plate upon a single particle of water placed at the distance a. Then, the density being constant and equal to unit, the attractive force of the plate upon the thin elementary section will be equal to

$$\Psi(a) \times \varpi da:$$

and hence the attraction of the plate upon all the water in the tube will be equal to the integral

$$\varpi \times \int \Psi(a).da,$$

generated while a increases from o to be infinitely great. The expression $\int \Psi(a).da$, which we may denote by K′, is therefore the force with which the attraction of the glass causes the fluid to press upon a square inch of the plate, or it is the measure of that force. If the particles of the fluid were attracted by the matter of the plate with an intensity equal to their own cohesive force, then K′ would be equal to K, that is, it would be equal to the force with which an indefinite mass of the fluid causes the superficial stratum to press inward.

In the inside periphery of the tube, assume any determinate length ab, equal to λ, and let the lines ac, bd, be drawn in the interior surface at right angles to ab. The area of the space $abdc$ is equal to $\lambda \times a$; and, because fluids press equally in all directions, the attraction which urges the elementary section towards the plate AB, will cause the fluid below the section to press upon the space $abdc$ with a force which is to the attractive force urging the section downward, as $\lambda \times a$ to the area of the section. Hence the pressure on the space $abdc$, caused by the attraction of the glass on the elementary section GH, is equal to

$$\lambda \times \Psi(a).ada.$$

This expression would evidently denote the pressure upon the surface $abdc$, if the fluid below the section were impelled towards the plate by a piston exactly fitted to the orifice of the tube. But there is no difference between the action of such a piston and that of the thin elementary section when urged by

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attraction with equal force in the same direction. The total force acting laterally in the length λ, is, therefore, equal to the fluent

$$\lambda \times \int \Psi(a).ada,$$

generated while a increases from o to be infinitely great. Hence, if we put $H' = \int \Psi(a).ada$; then H' will be the measure of the lateral force in the length equal to unit.

It is obvious, that the direct attraction between two portions of a fluid, as well as that between a solid and a fluid, is attended with a lateral pressure. If we denote by H, what H' becomes when the matter of the plate attracts the fluid with the same intensity that the fluid attracts its own particles, then H will be the measure of the lateral force arising from the direct attraction of the fluid, and it will have the same relation to K that H' has to K'.

The lateral force is always very small when compared with the direct pressure. For the function $\Psi(a)$ has a conceivable value only when a is so small as to be imperceptible to the senses; in such circumstances, the product $\Psi(a) \times a$ is very small when compared with $\Psi(a)$; and, consequently, $H' = \int \Psi(a)ada$ is considerable in respect of $K' = \int \Psi(a).da$.

The smallness of the lateral, in comparison of the direct, pressure, arises from this, that every elementary part of the latter is estimated on the same finite area, while the simultaneous element of the former is confined to a space incomparably less. These two pressures resemble the power in the hydrostatic paradox and the effect which it produces. In both cases we have a small pressure applied to a surface extremely minute, in equilibrium with a great pressure distributed over a comparatively large area.

When a piece of glass is partially plunged in water in a vertical direction, the thin film which is attracted by the immersed surface endeavours to spread itself on the glass with an effort more or less in proportion to the compressive force. Below the surface of the water, the lateral actions of the parts in contact mutually counteract one another; but at the surface, the expansive force meets with no opposition. The film will, therefore, be pushed above the general level, and as it acts by cohesion on the contiguous fluid, it will draw upward a portion of it, and form a ring surrounding the immersed part of the glass. The small fluid mass on which the glass exerts its attraction performs the office of a machine, which changes a horizontal force into one having a vertical direction. In the mechanical properties of a fluid, we thus have a principle adequate to account for what we observe in capillary action. But although the general view here given of the cause of the capillary phenomena is so far satisfactory, a great deal of discussion is still necessary, in order to deduce from it a clear explanation of the laws observed in the appearances that take place in different circumstances.

The idea of accounting for capillary action by means of the lateral force produced by the direct attraction of a solid body upon a fluid, is due to Professor Leslie, a philosopher to whom physical science is indebted for more than one discovery. It is developed and applied, to explain some of the principal phenomena, in a short dissertation published, in 1802, in the *Philosophical Magazine*. This dissertation is written with the same ability that characterizes all the productions of the author, and nothing more was necessary than to pursue the observation he had made, in order to obtain a complete theory of this branch of natural philosophy. It happens that, in this instance, the views of the philosopher are confirmed by the most abstruse and refined mathematical investigation. The formula found by Laplace, for the attractive force of a fluid bounded by a curve surface, consists of two parts, one of which is the same for all surfaces, and the other varies with the curvature in each particular case. The first of these terms is the attractive force of an indefinite mass of the fluid bounded by a plane. The other term, which depends upon the curvature, is composed of a constant quantity multiplied into half the sum of the reciprocals of the radii of the circles, which have the same curvature with any two sections of the curve surface made by planes, perpendicular to one another, and to the curve surface; and, on examination, this constant quantity will be found to coincide with the measure of the lateral tendency of the fluid caused by the direct action of the first force. Thus it appears, that the two quantities which enter into the formula of Laplace are no other than the measures of the two kinds of force which we have been considering; the one denoting the direct pressure caused by the attraction of a fluid mass bounded by a plane, and the other signifying the derivative force acting laterally, which is a necessary consequence of the direct pressure. In a subsequent part of this article, what has now been advanced will be proved, by deducing the formula of Laplace in a direct and satisfactory manner from the two kinds of force, with the consideration of which we have been occupied.

Manner in which the immersion of a solid body disturbs the equilibrium of a fluid.

6. Imagine a large vessel DGHF (fig. 3), which contains a fluid subjected to no forces but gravity and the attraction of its own particles, and consequently having its surface DF horizontal; let AB represent a rectangular plate partially plunged in the fluid which it attracts; and supposing the surface of the fluid to remain level, let it be proposed to investigate the force with which the attraction of the plate tends to disturb the equilibrium of the fluid.

Suppose a horizontal plane, df, to be traced in the fluid, at a depth equal to the range of the corpuscular force, then this plane will separate all the superficial strata, in which the pressure is variable, from the rest of the mass. Below the plane df, the fluid particles cohere with the same force in every part, and they are likewise attracted with equal intensity by all the points of the plate with which they are in contact; above the same plane the attractive force of the plate remains unchanged, but the pressure of the fluid in the different strata is variable, gradually becoming less and less as we approach the surface. It will, therefore, be proper, first to exa-

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mine what tendency the part of the plate below the plane df has to disturb the equilibrium; and, *secondly*, to consider the effect of the plate's attraction upon the superficial film or stratum.

If the matter of the plate have the same attraction for the particles of the fluid that they have for one another, we may consider the plate as a body of the fluid that has congealed without any other change; in which case, it is evident, that, below the superficial stratum, the cohesive force of the fluid particles will be equal to their adhesion to the plate, and the action of the solid matter will nowise disturb the equilibrium of the fluid in the vessel.

If the plate be supposed to have no attraction for the fluid, a canal having one end in the surface of the fluid, and the other end on the plate, will be similar to a canal terminating both ways in the fluid's surface. It will be in equilibrium by the mutual attractions of the particles within it, and will exert no pressure whatever upon the plate.

If the solid matter attract the particles of the fluid, but with less intensity than they attract one another, there will be an adhesion of the fluid to the plate in proportion to the attractive force. In this case, we may distinguish the attraction between the fluid particles into two parts, one of which is equal to, and in equilibrium with, the attraction of the solid matter; while the other part, which is over and above what balances the attraction of the solid matter, is in equilibrium by the mutual action of the particles upon another.

The solid matter acts immediately upon a thin portion of the fluid in contact with it; that portion attracts another contiguous portion; and, in this manner, the attraction of the plate reaches to any distance in the fluid mass. But from this it is manifest, that the whole of a force greater than the mutual attraction of the particles cannot be propagated to a distance. Part of it must remain confined to the sphere of immediate action. Hence, if the plate attract the particles of the fluid with greater intensity than they attract one another, a part only of the attraction of the solid matter will balance the whole attraction of the fluid; and the remaining part will not penetrate beyond the range of the corpuscular force, but will act only upon a thin film of the fluid in contact with the plate. In this case, therefore, the plate's attraction produces a force which is not absorbed by the fluid. As this force compresses the thin film on which it acts upon the plate's surface, it will be attended with a lateral pressure, or an effort of the film to spread itself on all sides; and it may at first be thought that this lateral tendency, by acting upon the superficial stratum, will disturb the equilibrium. But it will immediately occur, that the effort which the edge of the film adhering to the plate below the plane df, makes to raise up the superficial stratum, is counteracted by the opposite effort of the fluid situated immediately above the plane df. Thus, in every relation that can subsist between the attractive powers of the plate and the fluid, that part of the solid which is immersed below the superficial stratum, has no tendency to disturb the equilibrium of the fluid in the vessel.

Insufficiency of Laplace's Second Theory of Capillary Action.

Some philosophers account for capillary action, by means of attractions between the plate and the fluid, which are supposed to take place, partly at the surface of the fluid, and partly at the bottom of the plate. Laplace, in particular, has grounded his second, or more popular theory, entirely on such attractions. He observes, that the part of the plate's vertical plane, immersed in the water, attracts the fluid in contact with it as much upward as downward, and therefore has no effect in causing either an elevation or a depression; but the part above the water attracts a thin film in contact with the plate upward; and the whole vertical side of the plate likewise attracts in the same direction the fluid below it, and situated in its prolongation. According to Laplace, it is the united effect of these two attractions which supports the suspended ring. The whole of this reasoning appears to us gratuitous. No part of the fluid is attracted by the solid matter in a vertical direction, but in a direction perpendicular to the plate's surface. The immersed part of the solid presents a continuous surface to the fluid, attracting it with the same intensity at every point; whereas Laplace neglects the action of the plate's horizontal boundary, and seems to suppose that the attractive energy of the solid matter resides only in the vertical sides. We have endeavoured to prove, that the thin film, or coating of fluid, which covers the part of the solid immersed below the superficial stratum, is every where in a state of equilibrium and of equal compression by the attractions which act upon it. There is, therefore, no force produced at the bottom of the plate by the attraction between the solid matter and the particles of the fluid, which can contribute to support the weight of the ring raised above the level.

We proceed now to consider the action of the plate upon the superficial stratum. Trace a canal at right angles to the plate, of the same depth with the superficial film, and having its horizontal width equal to unit, and continue the canal till it terminate in a vertical plane PS, parallel to the plate. Let n be the small portion of the canal within the sphere of the plate's attraction, and suppose the canal to be divided in its whole length into the parallelopipeds m, m, m, &c., each equal to n. It is plain that the attractions of the fluid below the canal, and on the two sides of it, have no tendency to impel it in any direction, nor to impede the motion of the fluid along it. The canal is also in equilibrium with regard to gravity, since by the hypothesis it is horizontal. The rectangular wedge of fluid beyond the plane PS will attract the small parallelopiped contiguous to it with a force proportional to $\frac{1}{2}$K; because K denotes the attractive force of two rectangular wedges, § 5; and the same parallelopiped will also be attracted with an equal force in the opposite direction by the one next to it. In like manner, every parallelopiped in the canal is attracted with equal forces by those contiguous to it on opposite sides, except the one in contact with the plate, which is attracted in the direction of the canal with the force $\frac{1}{2}$K, and towards the plate, with the force K′, depending upon the intensity of the plate's attraction for the fluid.

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Now, if K' be just equal to $\frac{1}{2}K$, which will happen whenthe intensity of the plate's attraction is half that of the fluid, the parallelopiped n will be situated with regard to the forces that act upon it, similarly to the others in the canal; in this case, therefore, the insertion of the plate will not disturb the equilibrium of the fluid, the surface of which will remain horizontal.

If K' be greater than $\frac{1}{2}K$, it may be resolved into two parts, $\frac{1}{2}K + (K' - \frac{1}{2}K)$, of which one will counterbalance the opposite force, and reduce the canal to equilibrium; and the other part, $K' - \frac{1}{2}K$, will act only upon the parallelopiped n, and will compress it upon the surface of the plate. The compression will produce a lateral force proportional to $H' - \frac{1}{2}H$, which urges the small fluid mass to spread itself towards every side; and, as this force is unopposed vertically upward, the equilibrium of the fluid will be disturbed; the superficial film will ascend all round the plate, and, by means of the force of cohesion, will carry with it a portion of the fluid till the suspended weight is sufficient to counterbalance the force acting upward.

When K' is less than $\frac{1}{2}K$, the parallelopiped in contact with the plate will be more attracted in the direction of the canal than towards the plate. When this happens the fluid is depressed below the level by capillary action; but we shall leave this case to be afterwards considered, and at present confine our attention to the former case, when the fluid is elevated above the level.

Ring upon the surface of a solid Body plunged in a Fluid.

7. When the immersion of the plate causes an elevation, the fluid will assume the form of a concave ring as KLM (Plate LXXX. fig. 4.). If we suppose a superficial canal divided into parallelopipeds as before, we may prove, by like reasoning, that the attraction of the solid matter has no tendency to disturb the equilibrium of the fluid except by the lateral force which it communicates to the small parallelopiped in contact with it. And since the attractive force of the plate upon the particles of the fluid depends only upon their perpendicular distance from its surface, it readily follows that the lateral force will undergo no variation, but will remain constantly equal to $H' - \frac{1}{2}H$, both during the rising of the ring, and when it has attained the greatest elevation. The reciprocal attraction of all the fluid in the vessel, likewise produces pressures that are propagated inward from the surface of the fluid, and from the sides and bottom of the vessel, § 3; but these forces cannot be in equilibrium with the weight of the ring and the disturbing force arising from the plate's attraction. For the former forces have no tendency to move the centre of gravity of the whole mass, whereas the latter tend to produce motion in that point each in its own direction. In the case of equilibrium, therefore, the vertical force arising from the plate's attraction must be equal to the weight of the suspended ring; or, which is the same thing, $H' - \frac{1}{2}H$ will express the weight of a portion of the ring in every unit of the horizontal extent.

The vertical force produced by the attraction of the solid matter begins to act the instant the fluid comes into contact with the solid; it first causes the ring to rise, and then keeps it suspended.

If m^2 denote the area of a section of the ring made by a vertical plane perpendicular to the surface of the plate, then m^2, or $m^2 \times 1$, will be the volume of a portion of the fluid equal in weight to $H' - \frac{1}{2}H$.

Elevation of a Fluid between two parallel Plates.

If two parallel plates, AB and CD (fig. 5.), very near one another, have their lower ends immersed in a fluid, it is observed that the fluid will rise between them above the natural level. Conceive a superficial canal extending between the plates in a direction at right angles to their surfaces, having its depth equal to the greatest range of the corpuscular force, and its horizontal width equal to unit; then all the fluid below the canal will be in equilibrium with respect to the attractive forces that act upon it, and therefore the suspended weight must be supported by the action of the two plates upon the canal. Of the forces which act upon the canal, we may neglect the attraction of the fluid below it, which causes the particles in the inside to press perpendicularly on the bottom. At each end it is attracted by the plates with a force equal to K', or $\frac{1}{2}K + (K' - \frac{1}{2}K)$; and, at the vertical sides between the plates, by the fluid on the outside with a force equal $\frac{1}{2}K$. Wherefore, when the canal is reduced to equilibrium by equalizing the pressure upon its sides, there will remain at each end an excess of force equal to $K' - \frac{1}{2}K$, which compresses the fluid upon the plates; and the compressive force is necessarily accompanied with a lateral pressure equal to $H' - \frac{1}{2}H$, which tends upwards and supports the weight of the fluid suspended below the canal.

Hence the weight elevated between the plates, in the horizontal length λ is equal to $2(H' - \frac{1}{2}H) \times \lambda$; and, since $m^2 \times 1$ is the volume corresponding to the weight $(H' - \frac{1}{2}H) \times 1$, the volume corresponding to the weight $2(H' - \frac{1}{2}H) \times \lambda$, will be equal to $2m^2 \times \lambda$. Let D denote the distance of the plates, and Q the least height of the curve surface between them above the natural level, then, if we conceive a horizontal plane touching the curve surface at its lowest point, the whole fluid between the plates, in the length λ, will be composed of a small curved portion in the shape of a meniscus, and a parallelopiped equal in volume to $\lambda \times D \times Q$. Now, when the plates are very near one another, and the elevation is considerable in comparison of their distance, the meniscus will be so small, that the parallelopiped alone may be reckoned equal to the whole volume of the fluid. Hence, if we equate the two expressions of the same bulk, we shall get

$$D \times Q = 2m^2;$$

which proves, that the elevations of a fluid, between plates of the same matter, are reciprocally proportional to the distances of the plates; and this agrees with observation.

Elevation in a Capillary Tube.

When a capillary tube, or one with a bore less than one-tenth of an inch, is partly plunged in a fluid, the fluid will rise within the tube above the level on the outside. Let AB and CD (fig. 5.) represent the sides of such a tube, MHN the curve surface of the elevated column, having below it an imaginary surface at a depth equal to the range of the corpuscular force, and conceive two planes intersecting one another in the axis of the tube at any angle, then

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all the fluid below the superficial stratum will be in equilibrium with regard to the attractions to which it is subjected; and the triangular portion of that stratum, bounded by the inside of the tube, and the two planes intersecting in the axis, would likewise be in equilibrium, if the pressures upon all its vertical sides were equal. But the side in contact with the tube is attracted with a force equal to K′, or $\frac{1}{2}K+(K'-\frac{1}{2}K)$; and each of the other two sides is attracted with a force equal to $\frac{1}{2}K$; therefore, when the equilibrium of the attracting forces is provided for, there will remain an unbalanced pressure, proportional to $K'-\frac{1}{2}K$, upon the inside of the tube; and this direct compressive force is accompanied with a lateral tendency, proportional to $H'-\frac{1}{2}H$, which is directed upward, and sustains the elevated fluid between the two intersecting planes.

If π denote the circumference of a circle that has its radius equal to unit, and r the radius of the capillary tube, then $(H'-\frac{1}{2}H)\times r\pi$ will be the weight of the elevated column of fluid within the tube, and $m^2\times r\pi$ will be its bulk. Conceive a plane which touches the curve surface of the column at its lowest point, and let q be the height of that point above the level on the outside of the tube, then the elevated column will consist of a cylinder equal to $\frac{1}{2}r^2\pi q$, and a small meniscus above the cylinder; so that, in very small tubes, the cylinder may be taken for the whole bulk of the column; wherefore, by equating the two expressions of the same bulk, we get

$$\tfrac{1}{2}r\times q=m^2;$$

which proves, that, in small tubes of the same matter, the elevations are reciprocally proportional to the radii, or diameters of the tubes.

And because m^2 is the same in all cases, when plates and tubes of the same matter act on the same fluid, if we equate the values of it taken from the last expression, and from the expression formerly obtained for two plates, we shall get

$$H\times Q=r\times q;$$

and this shows, that a fluid will rise between two plates, to the same height it would do in a tube of the same matter, having its radius equal to the distance of the plates.

Theory of Dr Jurin.

The deductions that have now been drawn from the principle of a corpuscular attraction evanescent at all sensible distances, are equivalent to the account of capillary action founded on the hypothesis of Dr Jurin. Whatever may be thought of the physical principle advanced by this philosopher, it must be allowed, that his theory agrees well with observation; and it cannot be denied, that he has, with great sagacity, inferred from his experiments the true place in which the capillary force resides. But it is impossible to accede to his opinion, that, when a capillary tube of glass is immersed in water, the water within the tube is attracted upward by a narrow ring of glass immediately above the surface of the liquid. If the glass attract the water, the attraction must be perpendicular to the surface of the glass; the force acting on the fluid cannot be vertical, it must be horizontal; and if we would reason strictly, the proper inference must be, that an attraction between the glass and the water is alone insufficient to account for capillary action. In order to explain the phenomena, it is necessary to attend to the remark of Professor Leslie, founded on the properties essential to fluidity, namely, that a fluid cannot be attracted horizontally by a solid body, without having a vertical force communicated to it. It is certainly not a little surprising, that an observation made in 1802, so well calculated to remove all the difficulties of the theory, should have passed entirely unnoticed, although, since that period, the subject has engaged the attention of the first philosophers of the age.

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In what goes before, it has been shown, that, in many cases, the height to which a fluid will rise may be found with considerable exactness, by comparing the bulk as determined by the magnitude of the capillary force with the same bulk deduced from the figure which the displaced fluid is constrained to assume; but a rigorous investigation of all the circumstances attending the capillary phenomena requires further, that we know the nature of the curve assumed by that part of the fluid's surface, which is free to obey the impulse of all the forces that act upon it; and it is to this branch of the subject that we are now to proceed.

8. Resuming the first and simplest case of a single plate immersed in a fluid, which rises upon its surface in a concave ring, let a vertical plane PL (fig. 4.), parallel to the plate, and at a distance from its surface greater than the range of the corpuscular force, be drawn to intersect the curve, then the part of the ring cut off, being without the sphere of the plate's attraction, must be supported by the force with which it is attracted by the fluid between the plate and the plane. Now, all the fluid below the superficial stratum is in equilibrium with regard to the corpuscular forces to which it is subjected; and hence it is the attraction of the fluid between the plate and the plane upon the superficial stratum, which supports the part of the ring below the plane, in the same manner that the attraction of the plate upon the same stratum supports the whole ring. All the fluid in the vessel being supposed in equilibrium, we may conceive that the portion of it between the plate and the plane is converted into a solid without any other change of its properties; then, if we consider that part of the superficial canal which lies between the vertical plane and the level surface of the fluid, the upper end of it will be pressed against the imaginary solid by the attraction of an obtuse-angled wedge of the fluid, while the pressure upon all the other vertical sides is only equal to the attraction of a right-angled wedge; and the difference of these forces remaining unbalanced, generates the force which tends upward, and supports the weight of the part of the ring situated below the point of its action.

It is now necessary to determine the attractive force of a portion of a fluid, in the shape of a wedge, contained in any proposed angle. Suppose that a fluid mass bounded by the plane AB (fig. 6.) is divided by the plane PQ; and let it be required to find the force with which the attraction of the particles contained in each of the wedges APQ and BPQ, will cause a small drop placed at P to press upon the plane AB. Draw PN and PG to bisect the angles

APQ, BPQ; let the line PH, perpendicular to the plane AB, represent the force K, or the pressure of the drop caused by the attraction of all the fluid below the plane, § 3; and draw HN and HG perpendicular to PN and PG. It is manifest that the attraction of all the particles in the wedge APQ, is a force in the direction PN; and, in like manner, the attraction of the particles in the wedge BPQ is a force in the direction PG. Wherefore, since PH, the united effect of both attractions, is resolved into the forces PN and PG, it follows, that PN will represent the attraction of the obtuse-angled wedge upon the drop, and PG that of the acute-angled wedge. Draw NO and GL perpendicular to PH; then PO is the part of the force PN acting at right angles to the plane AB, and PL is the like part of the force PG. Draw NG, and let φ denote the angle HPQ, or the difference of each of the angles APQ and BPQ from a right angle. Then NG and PH are equal and bisect one another. Also, the angle PHG=BPG, each being the complement of HPG. Wherefore GCP=2PHG=2BPG=BPQ; and, taking the complements of the equal angles, CGL=CNO=HPQ=φ. Now GC=$\frac{1}{2}$PH=$\frac{1}{2}$K; hence CL=CO=$\frac{1}{2}$K $\sin\varphi$; therefore PO=$\frac{1}{2}$K+$\frac{1}{2}$K $\sin\varphi$, and PL=$\frac{1}{2}$K—$\frac{1}{2}$K $\sin\varphi$. Thus the pressure of the drop upon the plane AB, caused by the attraction of the obtuse-angled wedge, is equal to $\frac{1}{2}$K+$\frac{1}{2}$K $\sin\varphi$; and that caused by the attraction of the acute-angled wedge is equal to $\frac{1}{2}$K—$\frac{1}{2}$K $\sin\varphi$.

Curve formed upon the surface of a solid.

Returning, now, to the canal below the vertical plane PL (fig. 4.), and the level surface of the fluid, let θ denote the inclination of the curve at L to the horizon; the canal would be in equilibrium with respect to the corpuscular forces that act upon it, if the attractions upon all its vertical sides were equal. But, according to what has just been investigated, the upper end is attracted by the fluid beyond the vertical plane PL, with a force equal to $\frac{1}{2}$K+$\frac{1}{2}$K $\sin\theta$; and the attractions upon each of the remaining sides is only equal to $\frac{1}{2}$K; wherefore, there is an excess of attraction equal to $\frac{1}{2}$K $\sin\theta$, which causes the drop of liquid at the upper end of the canal to press upon the fluid above it, and which will be attended with a lateral force, equal to $\frac{1}{2}$H $\sin\theta$, acting upward and sustaining the part of the ring cut off by the vertical plane.

Let $\beta^2\times 1$ denote the volume of a portion of the fluid equal in weight to $\frac{1}{2}$H. Then $\frac{1}{2}$H $\sin\theta$ will be the weight, and $\beta^2\sin\theta$, the bulk of the partial ring cut off by the plane PL in the horizontal extent equal to unit. Let y denote the vertical ordinate of a point in the curve, formed by the intersection of the ring, with a vertical plane perpendicular to the plate; and let x be the corresponding horizontal ordinate, or the distance of y from the plate. Then the area of the curve below the point L is equal to $\int ydx$, the fluent vanishing with y; and the volume of the partial ring in the horizontal extent equal to unit, is equal to $1\times\int ydx$. Hence if we put $z=\sin\theta$, and equate the two expressions of the same bulk, we shall get these equations which are sufficient to determine the nature of the curve, viz.

$$\beta^2 z=-\int ydx$$

$$-\frac{dy}{dx}=\frac{z}{\sqrt{1-z^2}}:$$

the negative signs must be used, because z and y both decrease when x increases.

From the first of these equations we get

$$-ydx=\beta^2 dz;$$

and, if this be multiplied into the second equation, there will result

$$ydy=\frac{\beta^2 zdz}{\sqrt{1-z^2}};$$

that is, since $z=\sin\theta$, $ydy=\beta^2 d\theta\sin\theta$; whence $y^2=2\beta^2(1-\cos\theta)=4\beta^2\sin^2\frac{1}{2}\theta$; and

$$y=2\beta\sin\tfrac{1}{2}\theta.$$

Again, $dz=d\theta\cos\theta=d\theta(1-2\sin^2\frac{1}{2}\theta)$; therefore,

$$-dx=\frac{\beta^2 dz}{y}=\beta\cdot\left\{\frac{\frac{1}{2}d\theta}{\sin\frac{1}{2}\theta}-2.\tfrac{1}{2}d\theta\sin\tfrac{1}{2}\theta\right\};\text{ and,}$$

hence,

$-x+\beta\log\tan\frac{1}{4}t-4\beta\sin^2\frac{1}{4}t=\beta\log\tan\frac{1}{4}\theta-4\beta\sin^2\frac{1}{4}\theta$,
t being the value of θ when $x=o$. Therefore,

$$x=\beta\times\log\frac{\tan\frac{1}{4}t}{\tan\frac{1}{4}\theta}-4\beta\left\{\sin^2\tfrac{1}{4}t-\sin^2\tfrac{1}{4}\theta\right\}.$$

The value of the ordinate shows, that x increases without limit as y decreases. Whence it follows, that the curve has an asymptote in the level surface of the fluid.

Curve between two parallel plates.

In like manner, we may investigate the curve formed by the intersection of the fluid between two parallel plates and a vertical plane perpendicular to the plates. Let y denote the height above the natural level of a point in the curve, and x the distance of y from the middle of the plates, or from the point where y is least. Suppose two vertical planes, PO and QR, parallel to the plates and at equal distances from them; then, as before, the fluid on the outside of the planes PO and QR will attract the ends of the superficial canal between them with a force equal to $\frac{1}{2}$K+$\frac{1}{2}$K $\sin\theta$; and, as the part $\frac{1}{2}$K is alone sufficient for the equilibrium of the canal, it follows, that the other part $\frac{1}{2}$K $\sin\theta$ will compress the fluid in contact with the two planes, producing thereby a lateral pressure that tends upward and sustains the weight of the suspended fluid. Hence the weight of the fluid suspended between the planes PO and QF, in every unit of the horizontal length, is equal to $2\times\frac{1}{2}$H $\sin\theta$; and its bulk is equal to $2\beta^2\sin$. But the same bulk is also equal to $2\times\int ydx$, the fluent vanishing with x. Wherefore, by putting $z=\sin\theta$, and equating the two expressions of the same bulk, we get the equations

$$\int ydx=\beta^2 z$$

$$\frac{dy}{dx}=\frac{z}{\sqrt{1-z^2}},$$

which determine the nature of the curve.

By combining the two equations, we get, $ydy=\frac{\beta^2 zdz}{\sqrt{1-z^2}}$: now let $u=\sin\frac{1}{2}\theta$; then $z=\sin\theta=2u\sqrt{1-u^2}$, and $\frac{dz}{\sqrt{1-z^2}}=\frac{2du}{\sqrt{1-u^2}}$: hence $ydy=4\beta^2 udu$, and

$$y=2\beta\sqrt{q^2+u^2}$$

$2\beta q$ being the height of the lowest point of the curve above the level.

Again $dx=\frac{\beta^2 dz}{y}=\beta.\ \frac{du(1-2u^2)}{\sqrt{1-u^2\,.\,q^2+u^2}}$; therefore,

$$x=\beta.\int\frac{du(1-2u^2)}{\sqrt{1-u^2\,.\,q^2+u^2}};$$

and x will be obtained by the rectification of the conic sections.

Curve surface in a Capillary Tube.

In the case of a capillary tube, conceive an imaginary tube, of which the sides are PO and QR (fig. 5.), within the real one, and let θ denote the inclination of the curve surface to the horizon at the points P and Q. The elevated column, within the imaginary tube, is supported by the attraction of the fluid between the two tubes, in the same manner that the whole capillary column is supported by the attraction of the solid matter of the real tube. The fluid in contact with the imaginary tube on the outside, having the shape of a wedge contained in the obtuse angle $90^0+\theta$, will attract the fluid in the inside in a horizontal direction with a force equal to $\frac{1}{2}K+\frac{1}{2}K\sin\theta$; and of this force the part $\frac{1}{2}K\sin\theta$ will compress the fluid ring on which it acts, producing, by this means, a lateral tendency upward, proportional to $\frac{1}{2}H\sin\theta$, which supports the weight of the suspended column. If r denote the radius of the imaginary tube, then $\frac{1}{2}H\sin\theta\times r\pi$ will be equal to the weight, and $\beta^2\sin\theta\times r\pi$, to the bulk of the elevated column within that tube; and, if y be the vertical ordinate of a point in the curve surface, or the height above the natural level, and r the horizontal distance of y from the axis of the tube, the bulk of the same column will be equal to $\pi\int y\mathrm{r}d\mathrm{r}$, the fluent vanishing with r. Wherefore, by equating the equivalent expressions, we shall get the following equations which determine the nature of the curve surface, viz.

$$\beta^2\mathrm{r}z=\int y\mathrm{r}d\mathrm{r}$$

$$\frac{dy}{d\mathrm{r}}=\frac{z}{\sqrt{1-z^2}}.$$

If these equations be combined so as to exterminate y, a differential eqation between r and z will be obtained, viz.

$$\frac{d.\left(\frac{d\,.\,\mathrm{r}z}{\mathrm{r}d\mathrm{r}}\right)}{d\mathrm{r}}=\frac{1}{\beta^2}\times\frac{z}{\sqrt{1-z^2}}$$

Curve when a Fluid is depressed below the Level.

9. Having explained the most remarkable instances of elevation by capillary action, we must now turn our attention to the cases where a fluid is depressed below the level by the same cause. It has been shown that an elevation will always take place when K' and H' are greater than $\frac{1}{2}K$ and $\frac{1}{2}H$, and that the fluid will remain level, when the same quantities are equal. It follows, therefore, that the fluid will sink below the level when the former quantities are less than the latter; for otherwise there could not be an equilibrium. The shortest and most perspicuous manner of explaining the cases when a fluid is depressed is to compare them with the similar cases of an elevation. Suppose that AB and ab (fig. 7. and 8.) are two plates of different kinds of matter immersed in the same fluid, which they attract with intensities equally above and below the mean quantity $\frac{1}{2}K$, we shall prove that the same curve which is formed above the level on the surface of the one, will be in equilibrium by the action of the other when placed upon its surface in a reversed position below the level.

Conceive the two curves to be intersected at intervals equal to the range of the corpuscular force by an indefinite number of planes parallel to the plates; and let the curves, at L and l (fig. 7.), have the same inclination θ, to the horizon. In the curve above the level, it has been shown, that the force which tends upward, and supports the part of the ring below L, is equal to $\frac{1}{2}H\sin\theta$; and, in like manner, the force which supports the part of the ring below the point O, indefinitely near L, is equal to $\frac{1}{2}H\,.\,(\sin\theta+d\sin\theta)$. Therefore, the difference of these forces, or $\frac{1}{2}H\,.\,d\sin\theta$, which may be considered as a force urging the curvilineal element OL upward, is equal to the weight of the fluid elevated between the planes passing through O and L. In effect, if we put y and x to denote the vertical and horizontal ordinates of the point L, and equate the two expressions of the bulk of the small portion of fluid above mentioned, we shall get,

$$\beta^2 d\sin\theta=\beta^2 dz=ydx,$$

which is no other than the differential of the equation formerly obtained, (§ 7.) We may therefore conceive that every element of the curve is urged upward with a force equal to the weight of the elevated fluid below it, the attraction of the plate supplying the force necessary to sustain the accumulated weight of all the suspended fluid.

In the curve below the level (fig. 8.), the fluid on the same side of the plane tl with the plate ab, attracts the particles on the other side of that plane: and as the attracting fluid forms an acute-angled wedge contained in the angle $klt=90^0-\theta$, the horizontal attraction will be equal to $\frac{1}{2}K-\frac{1}{2}K\sin\theta$; and the lateral force thence arising and acting vertically to $\frac{1}{2}H-\frac{1}{2}H\sin\theta$. The point l of the curve is therefore urged upward, by the attraction of the fluid between it and the plate ab, with a force equal to $\frac{1}{2}H-\frac{1}{2}H\sin\theta$; and, in like manner, the point o indefinitely near l, tends upwards with the force $\frac{1}{2}H-\frac{1}{2}H\,.\,(\sin\theta+d\sin\theta)$. The difference of these forces, which may be considered as a force applied to the curvilineal element ol, is equal to $-\frac{1}{2}Hd\sin\theta$; and it is the same in quantity as in the other curve, but has an opposite direction. The difference in the directions of the two forces acting

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upon the elements of the two curves arises from this, that, in the curve above the level, the force acting upward continually increases from the level surface to the plate, whereas, in the curve below the level, it continually decreases. Again, because OL and *ol* are placed at equal distances above and below the general level of the fluid, the weight drawing the element OL downward will be just equal to the vertical pressure caused by the superincumbent fluid, and urging the element *ol* upward. It thus appears that the forces which act upon the like elements of the two curves are the same in quantity, but that they have their directions reversed, which proves that, because the one curve is in equilibrium, the other will be so too; at least this will be the case if the attraction of the plate *ab* be sufficient to maintain the lowest point of the convex curve in its place.

The parts of the curves between the level surface of the fluid and the planes TL and *tl* are kept in their places by the horizontal attraction of the fluid on the other side of the same planes. These attractions are respectively equal to $\frac{1}{2}K+\frac{1}{2}K\sin\theta$ and $\frac{1}{2}K-\frac{1}{2}K\sin\theta$; and the one as much exceeds the mean quantity $\frac{1}{2}K$ as the other falls short of it. Now, in place of the attractions of the fluid particles contained in the wedges KLT and *klt*, we may substitute the attractions of two solid plates that act upon the fluid with equal forces; and these plates will come under the condition we have supposed with respect to the attractions of the plates AB and *ab*. It follows, therefore, that, because the attraction of the plate AB maintains the concave curve in its place, the attraction of the plate *ab* will be sufficient to maintain the convex curve in its place.

It is evident that the same reasoning which has been applied to two solid plates, will apply equally in all other cases, and we may lay down this general proposition, viz.: If two solid bodies, perfectly equal and similar, but composed of different kinds of matter, be immersed in a fluid which they attract with intensities equally different from the mean quantity $\frac{1}{2}K$, the fluid will be raised above the level by the action of the one, and depressed below the level by the action of the other, and the convex curve below the level will differ from the concave curve above the level in no respect, except that it will have a reversed position.

Limit to the elevation and depression of a fluid.

As no bounds can be set to the attractive force which a solid body exerts upon the particles of a fluid, it may be asked, will the weight displaced by capillary action increase in proportion to the attraction of the solid? Or, are there any conditions that confine the effect within a certain limit, however great may be the attraction of the solid? In answer to this, it must be observed, that the action of the solid matter is confined to a thin film of the fluid in contact with it; and that it is this film alone which acts on the particles beyond it, and keeps them suspended by means of the force of cohesion. Hence the weight maintained above the level can never exceed what this last force is able to support. The elevation of the fluid will there be regulated by the attractive force of the solid matter, only so long as that force is less than the mutual attraction of the fluid particles; and the fluid will always rise to the same height when the attraction of the solid matter is either equal to, or greater than, the fluid's cohesion. In all these cases, the solid is wetted by the fluid, and we may conceive that it becomes covered with a coating of sufficient thickness to shield the particles on the outside from the attraction of the solid matter, a new body being thus formed, which attracts the fluid with a force equal to its own cohesive power.

From the relation that has been shown to take place between the cases of equal elevation and depression, it follows that the greatest depression will take place when a solid has no attraction for the particles of a fluid. If we go beyond this limit, and suppose that the solid matter repels the fluid, the capillary effect will not be heightened; for the repulsive force will be confined to the particles within the range of its action; beyond this insensible distance the repelling power will produce no effect; and the fluid will be left to assume the same figure it would do if no such power existed.

Angle of contact.

10. In the several cases that have been considered, the weight of the fluid suspended below that point of the curve surface which is inclined to the horizon in the angle θ, has been found to be equal to $\frac{1}{2}H\sin\theta$; wherefore, if ε denote the angle of contact, or the angle in which the surface of the fluid intersects the solid, then $90^0-\varepsilon$ will be the limit of θ, or what θ becomes at the surface of the solid; and consequently the weight of the whole fluid suspended by capillary action will be equal to $\frac{1}{2}H\cos\varepsilon$; but, as has likewise been proved (§ 7), the same weight is also equal to $H'-\frac{1}{2}H$; and hence, by equating the equivalent quantities, we get

$$H'=H\cos^2\tfrac{1}{2}\varepsilon.$$

This expression is possible only when H' is not greater than H; but we must not infer that the theory leads to any contradiction in the case where a solid body attracts the particles of a fluid with an intensity greater than their own mutual action upon one another. The equation is a consequence of the equality that takes place between the vertical force $H'-\frac{1}{2}H$ derived from the attraction of the solid, and the weight of the displaced fluid deduced from the figure which the attraction of its own particles causes it to assume. It is, therefore, only the effective part of the force $H'-\frac{1}{2}H$, or that which is really employed in displacing the fluid, that can enter into the equation; and when a part of the same force has no effect in elevating or depressing the fluid, that part must be neglected. Now, it has been proved that, however great the force $H'-\frac{1}{2}H$ may be, the capillary effect can never exceed that produced by the force $H'-\frac{1}{2}H$ (§ 9), and hence it appears, from the principle on which the investigation proceeds, that, in the equation, H' must be limited not to exceed H, which must be taken for its value in all cases when the solid matter acts upon the fluid particles with an intensity either equal to, or greater than, their own mutual attraction.

From this equation, it follows that the angle of contact is always the same when different solids of

Fluids.

the same attractive powers are immersed in the same fluid, a property that was first noticed by Dr Young.

The weight of the displaced fluid being equal to $\frac{1}{2}$H cos ε, is in every case proportional to the cosine of the angle of contact.

Investigation of Laplace's formula for the attraction of a fluid mass bounded by a curve surface.

11. In order still farther to illustrate and confirm the principles of the theory we have been explaining, we shall conclude this article with applying them to demonstrate the formula found by Laplace for the attraction of a fluid mass bounded by a curve surface.

Conceive a fluid mass bounded by a curve surface concave outward, and let the plane M A N (fig. 9.) be a tangent, and the straight line AO a normal, to the curve surface at any point A; through AO draw any two planes perpendicular to one another, which cut the surface of the fluid in the curve lines BA and CA, and let DC and DB be two other sections of the fluid's surface made by planes parallel to the first planes, and indefinitely near them. Put ds and ds' for the small curve lines AB and AC; and $d\theta$ and $d\theta'$ for the measures of the small angles which the tangents drawn to the curve lines from the points B and C make with the tangent plane MAN. The four planes intersecting the fluid contain within them a rectangular prism, standing upon the base ABDC, and extending into the interior of the fluid mass at right angles to the curve surface; it is required to find the force which urges the prism outward above the tangent plane.

Conceive a surface intersecting the prism at a depth below its base equal to the range of the corpuscular force, then all the fluid of the prism below this imaginary surface being in equilibrium with regard to the attractions to which it is subjected, we have only to examine the forces that act upon the superficial stratum. It is attracted by the particles below the imaginary surface, and by the fluid on the outside of the force bounding planes. The attraction of the particles below the imaginary surface is at every point perpendicular to that surface; and, therefore, the stratum would be in equilibrium, if the attractions upon its four sides were equal. The fluid on the outside of each of the two planes AB and AC is a rectangular wedge; and consequently the attractions upon the particles within the stratum causing them to press perpendicularly upon these planes, are each proportional to $\frac{1}{2}$ K. On the outside of the plane DC, the fluid is a wedge contained in the obtuse angle $90^0+d\theta'$; and on the outside of the plane BD, it is a wedge contained in the obtuse angle $90^0+d\theta$; the attraction is, therefore, proportional to $\frac{1}{2}K+\frac{1}{2}Kd\theta'$ in the first case, and to $\frac{1}{2}K+\frac{1}{2}Kd\theta$ in the other case. Hence, after the attractions upon the sides of the stratum are equalized, there is an excess of force perpendicular to each of the planes CD and DB amounting respectively to $\frac{1}{2}Kd\theta'$ and $\frac{1}{2}Kd\theta$. These direct forces produce the corresponding lateral pressures $\frac{1}{2}Hd\theta'$ and $\frac{1}{2}Hd\theta$; of which the first is the force, in the length equal to unit, urging the fluid in contact with the plane CD to ascend above the tangent plane, and the second is the like force acting upon the fluid in contact with the plane BD. Therefore the actual forces which, in the lengths DC and DB impel the superficial stratum, and consequently the prism attached to it by cohesion, above the tangent plane, are respectively equal to $\frac{1}{2}Hd\theta'ds$ and $\frac{1}{2}Hd\theta ds'$. It must be observed that these forces, like the curvatures from which they arise, are independent of one another; and that any alteration in the intensity of one will in no degree affect the action of the other. We may, therefore, conceive them to be applied to the prism one after the other; in which case the centre of gravity of the prism will have the same motion communicated to it as it would have if it were acted upon by the sum of both, or by the single force,

$$\tfrac{1}{2}Hd\theta'ds+\tfrac{1}{2}Hd\theta ds';$$

and this must, therefore, be considered as the effective force which pushes the prism above the tangent plane.

Let R and R$'$ be the radii of the circles that have the same curvature with the sections BA and CA, at the point A; then the small arcs AB and AC will subtend angles at the centres of the circles respectively, equal to $d\theta$ and $d\theta'$; consequently $ds=Rd\theta$, and $ds'=R'd\theta'$; $d\theta=\frac{ds}{R}$, and $d\theta'=\frac{ds'}{R'}$; and, if these values be substituted in the expression of the force, it will become

$$\tfrac{1}{2}H.\left\{\frac{1}{R}+\frac{1}{R'}\right\}.dsds'.$$

Since ds and ds' are entirely arbitrary, we may suppose that $dsds'$, the base of the prism, is constant or equal to unit; then the measure of the attractive force arising from the curvature of the surface, and lifting the prism above the tangent plane, will be equal to

$$\tfrac{1}{2}H.\left\{\frac{1}{R}+\frac{1}{R'}\right\}.$$

This expression would not be a proper measure of the attractive force, unless $\frac{1}{R}+\frac{1}{R'}$ have the same value at the same point of the curve surface, for any two planes perpendicular to one another and to the curve surface; but this is a well known property belonging to all curve surfaces.

If the surface of the fluid be convex outward, the preceding expression will become negative, and the force will change its direction and draw the prism inward, below the tangent plane.

The force arising from the curvature of the surface is independent of the direct attraction of the fluid mass upon the prism. This last force is proportional to K; it is the same whatever be the figure of the fluid, and it is always directed inward. (§ 3.) The whole force which draws inward a column upon a given base is, therefore, proportional to

$$K-\tfrac{1}{2}H.\left\{\frac{1}{R}+\frac{1}{R'}\right\}.$$

This is the formula of Laplace; and the manner in which we have obtained it proves clearly that the

symbol which makes its appearance in the analytical operations of the illustrious geometer, is, in reality, the measure of the lateral pressure necessarily attending the direct attraction of the particles of a fluid.

In a fluid mass, which is subjected to no forces but the attractions of its own particles, and which is in equilibrium, if we conceive a slender canal passing through the interior and forming a communication between any two points of the surface, the canal will be in equilibrium taken separately (fig. 1.). Of the forces in action at the ends, those which arise from the direct attraction of the whole mass, being equal and opposite, counteract one another in all positions of the canal; but the other forces, which depend on the curvature, and which, in reality, are nothing more than the lateral tendencies outward, produced by the direct attraction of the particles surrounding the two orifices, cannot be equal to one another in all positions of the canal, unless the function

$$\frac{1}{R}+\frac{1}{R'}$$

have the same value at all points of the curve surface, which is the case in no solid figure except a sphere. Such a body of fluid, therefore, cannot be in equilibrium unless its form be perfectly spherical.

The formula of Laplace must be considered as a great step made in this branch of natural philosophy, not only because it ascertains the connection between the pressure and the curvature, in which it agrees with the hypothesis of Segner and Dr Young, but also because it brings into view the forces K and H, and draws the attention to the relation they have to one another, and to the primitive attraction of the particles. The labours of philosophers have discovered the facts of capillary action, which have been verified by innumerable experiments; but if the truth is to be told, it may be affirmed that, reckoning back from the present time to the speculations of the Florentine academicians, the formula of Laplace, and the remark of Professor Leslie relating to the lateral force, are the only approaches that have been made to a sound physical account of the phenomena.

Method of computing the Depression of the Mercury in the Tubes of Barometers.

It is a problem of no small difficulty to determine the vertical ordinates of the curve surface in a capillary tube from the differential equations that have been investigated. The research possesses considerable interest, as it applies to the correction of the observed heights of the mercury in a barometer, by enabling us to compute the depression arising from capillary action. It is more particularly with a view to this application that the problem is here very briefly considered.

Resuming the equations of the curve surface in a tube, found in § 8, we get

$$y=\beta^2\left\{\frac{dz}{dr}+\frac{z}{r}\right\}$$

$$\frac{d.\left(\frac{d.zr}{rdr}\right)}{dr}=\frac{1}{\beta^2}\cdot\frac{z}{\sqrt{1-z^2}}:$$

and, if we put $x=\frac{r}{\beta}$, these equations will become

$$\frac{y}{\beta}=\frac{dz}{dx}+\frac{z}{x}$$

$$\frac{d.\left(\frac{d.zx}{xdx}\right)}{dx}=\frac{z}{\sqrt{1-z^2}}\quad\ldots\ldots(1).$$

In these equations, when $x=o$, we have $\frac{dz}{dx}=\frac{z}{x}$: and hence, if q denote the elevation or depression, or the least value of y, then $\frac{q}{\beta}=2\frac{z}{x}$, when $x=o$.

When z is small the equation (1) will coincide very nearly with the more simple equation

$$\frac{d.\left(\frac{d.wx}{xdx}\right)}{dx}=w.\quad\ldots(2).$$

And if, in this last equation, we put $w=\lambda x$, $x^2=4t$, we shall get

$$\frac{dd.\lambda t}{dt^2}=\lambda:$$

hence,

$$\lambda=1+\tfrac{1}{2}t+\frac{1}{1^2 2^2 3}t^2+\frac{1}{1^2 2^2 3^2 4}t^3+\&c.$$

Again, if we put $\lambda=c^{\frac{1}{2}\int vdt}$, c being the base of the hyperbolic logarithms, we shall get by substitution,

$$\tfrac{1}{2}\frac{dv}{dt}t+\frac{v^2}{4}t+v=1;$$

and hence,

$$v=1-\frac{1}{6}t+\frac{1}{24}t^2-\frac{1}{90}t^3+\frac{13}{4320}t^4-\&c.$$

Thus we have these two expressions of w, viz.

$$w=x\cdot\lambda=2\sqrt{t}\cdot\lambda$$

$$w=x\cdot c^{\frac{1}{2}\int vdt}=2\sqrt{t}\cdot c^{\frac{1}{2}\int vdt}$$

each of which, being multiplied by a constant quantity, will exhibit the general value, on the supposition that w vanishes with x: but the constant quantity is not necessary for the purpose we have in view.

Now, let $z=\frac{w\cdot s}{2}$: then, on account of the equations (1) and (2), we shall readily get,

$$\frac{dds}{dx^2}+\frac{ds}{xdx}+2\frac{dw}{wdx}\cdot\frac{ds}{dx}=\frac{s}{\sqrt{1-\frac{w^2s^2}{4}}}-s\ldots(A)$$

which may be thus written:

$$\frac{d.\left(\frac{ds}{xdx}x^2\right)}{xdx}+2\frac{dw}{wxdx}\cdot\frac{ds}{xdx}x^2=\frac{s}{\sqrt{1-\frac{w^2s^2}{4}}}-s;$$

but $xdx=2dt$, $\frac{\wedge}{xdx}x^2=2\frac{ds}{dt}t$, and $2\frac{dw}{wxdx}=\frac{1}{2}\cdot\frac{1}{t}+\frac{1}{2}v$; therefore, we have

$$\frac{d.\left(\frac{ds}{dt}t\right)}{dt}+\frac{ds}{dt}+v\frac{ds}{dt}t=\frac{s}{\sqrt{1-\frac{w^2s^2}{4}}}-s;$$

and if we multiply both sides by $c^{\int vdt}$ and expand the radical on the right hand side, we shall get

$$\frac{d.\left\{\frac{ds}{dt}t^2c^{\int vdt}\right\}}{t\,dt}=\frac{t}{-}.s^3.c^{2\int vdt}$$

$$+\frac{3t^2}{8}.s^5.c^{3\int vdt}$$

$$+\frac{5t^3}{16}.s^7.c^{4\int vdt}$$

$$+\text{\&c.}$$

In order to integrate this expression, assume

$$\frac{ds}{dt}t^2=k^3.\text{M}+k^5.\text{M}'c^{\int vdt}+k^7.\text{M}''.c^{2\int vdt}\ \text{\&c.}$$

$$s=k+k^3.\text{N}+k^5.\text{N}'c^{\int vdt}+k^7\text{N}''c^{\int 2vdt}+\text{\&c.}$$

then, by substituting these values, and equating the terms containing the like powers of k, we shall get

$$\left.\begin{aligned}&\frac{d\text{M}}{dt}+v\text{M}=\frac{t^2}{2}.c^{\int vdt}\\&\frac{d\text{N}}{dt}=\frac{\text{M}}{t^2}\end{aligned}\right\}$$

$$\left.\begin{aligned}&\frac{d\text{M}'}{dt}+2v\text{M}'=\frac{3}{8}t^3c^{\int vdt}+\frac{3t^2}{2}\text{N}\\&\frac{d\text{N}'}{dt}+v\text{N}'=\frac{\text{M}'}{t^2}\end{aligned}\right\}$$

&c.

Now, if we expand $c^{\int vdt}=\lambda^2$ in a series, we shall get, by means of the two first equations, first a value of M, and then one of N, each in a series: and by a like procedure with the other equations, it will be found that

$$\text{N}=t.\text{Q}=t.\left\{\frac{t}{12}+\frac{t^2}{36}+\frac{11.t^3}{1440}+\frac{t^4}{1200}+\frac{19.t^5}{120960}+\text{\&c.}\right.$$

$$\text{N}'=t^2.\text{Q}'=t^2.\left\{\frac{t}{32}+\frac{t^2}{128}+\frac{17.t^3}{5760}+\frac{t^4}{7560}+\text{\&c.}\right.$$

$$\text{N}''=t^3.\text{Q}''=t^3.\left\{\frac{t}{64}+\frac{3.t^2}{640}+\frac{163.t^3}{161280}+\frac{823.t^4}{2257920}+\text{\&c.}\right.$$

$$\text{N}'''=t^4.\text{Q}'''=t^4.\left\{\frac{7.t}{768}+\frac{t^2}{256}+\frac{t^3}{286720}+\text{\&c.}\right.$$

These formulæ will enable us to compute the values of Q, Q′ &c. with sufficient exactness when t is not extremely large. By substituting in the assumed value of $s=\frac{2z}{w}=\frac{2z}{x.\lambda}$, and observing that $\lambda^2 = c^{\int vdt}$, we shall get

$$\frac{2z}{x.\lambda}=k+k^3.t\lambda^2.\frac{\text{Q}}{\lambda^2}+k^5t^2\lambda^4.\frac{\text{Q}'}{\lambda^2}+\text{\&c.}$$

and hence if we put $f=\frac{kx\lambda}{2z}$, we shall have

$$1=f+f^3.\frac{\text{Q}z^2}{\lambda^2}+f^5.\frac{\text{Q}'z^4}{\lambda^2}+f^7.\frac{\text{Q}''z^6}{\lambda^2}+f^9.\frac{\text{Q}'''z^8}{\lambda^2}+\text{\&c.}\ .\ (3)$$

In this method of proceeding the coefficients in the series for f are in every case very small, and decrease so fast, that a few of the first terms determine the value of f with sufficient exactness. In reality, as t increases, each of the coefficients increases from 0 to a certain limit; whence it follows that f will decrease from 1 to a certain limit which is greater than $\frac{24}{25}$.

In order to prove what has been advanced, and to determine the limit of f, assume $w=\frac{u}{\sqrt{x}}$, and substitute in the equation (2); then,

$$\frac{ddu}{dx^2}=\left(1+\frac{3}{4}\cdot\frac{1}{x^2}\right).u:$$

Again, put $u=c^{\int\varrho dx}$; then,

$$\frac{d\varrho}{\delta x}+\varrho^2=1+\frac{3}{4}\cdot\frac{1}{x^2}:$$

and hence,

$$\varrho=1+\frac{3}{8}\cdot\frac{1}{x^2}+\frac{3}{8}\cdot\frac{1}{x^3}+\frac{63}{128}\cdot\frac{1}{x^4}+\text{\&c.}$$

In consequence of the different assumptions, we have

$$w=x.\lambda=\frac{c^{\int\varrho\delta x}}{\sqrt{x}}.$$

The expression $\frac{c^{\int\varrho dx}}{\sqrt{x}}$ will represent every value of w that vanishes with x; for it vanishes with x, and we conceive that $\int\varrho dx$ contains an arbitrary constant not necessary to be determined here.

If now we substitute this value of w in the equa-

tion (A), and observe that $2\frac{dw}{wdx}=-\frac{1}{x}+2\varrho$, we shall get

$$\frac{dds}{dx^2}+2\varrho\frac{ds}{dx}=\frac{s}{\sqrt{1-\frac{s^2}{4x}\cdot c^{2\int\varrho dx}}}-s:$$

and, by multiplying both sides by $c^{2\int\varrho dx}$, and expanding the radical, we have

$$\frac{d\cdot\left\{\frac{ds}{dx}c^{2\int\varrho dx}\right\}}{dx}=\frac{1}{4}\cdot\frac{s^3}{2}\cdot\frac{c^{2\int\varrho\delta x}}{x}$$
$$+\frac{1}{16}\cdot\frac{3s^5}{8}\cdot\frac{c^{4\int\varrho dx}}{x^2}$$
$$+\ \&c.$$

In order to integrate this expression, we may assume,

$$\frac{ds}{dx}=\frac{k^3}{4}\cdot \mathrm{M}\,c^{2\int\varrho dx}+\frac{k^5}{16}\cdot \mathrm{M}'\,c^{4\int\varrho dx}+\&c.$$

$$s=k+\frac{k^3}{4}\cdot \mathrm{N}\,c^{2\int\varrho dx}+\frac{k^5}{16}\cdot \mathrm{N}'\,c^{4\int\varrho dx}+\&c.$$

then, by substituting and proceeding as before, we shall get

$$\left.\begin{array}{l}\frac{d\mathrm{M}}{dx}+4\varrho\cdot\mathrm{M}=\frac{1}{2}\cdot\frac{1}{x}\\ \frac{d\mathrm{N}}{dx}+2\varrho\cdot\mathrm{N}=\mathrm{M}\end{array}\right\}$$

$$\left.\begin{array}{l}\frac{d\mathrm{M}'}{dx}+6\varrho\,\mathrm{M}'=\frac{3}{8}\cdot\frac{1}{x^2}+\frac{3}{2}\cdot\frac{\mathrm{N}}{x}\\ \frac{d\mathrm{N}'}{dx}+4\varrho\,\mathrm{N}'=\mathrm{M}'\end{array}\right\}$$

&c.

By means of the two first equations, we get

$$\mathrm{N}=\frac{1}{16}\cdot\frac{1}{x}+\frac{3}{64}\cdot\frac{1}{x^2}+\frac{1}{128}\cdot\frac{1}{x^3}-\frac{9}{128}\cdot\frac{1}{x^4}--$$

&c. This series will coincide with its first term in the extreme case, when x is very great; and by applying the like method of investigation to the other quantities sought, it will be found that

$\mathrm{N}=\frac{1}{16}\cdot\frac{1}{x}$; $\mathrm{N}'=\frac{5}{256}\cdot\frac{1}{x^2}$; $\mathrm{N}''=\frac{119}{12288}\cdot\frac{1}{x^3}$; $\mathrm{N}'''=\frac{393}{65536}\cdot\frac{1}{x^4}$. Now, let these quantities be substituted in the assumed value of s, and, because $w=x\cdot\lambda=\frac{c^{\int\varrho dx}}{\sqrt{x}}$, we shall get

$$=\frac{2z}{x.\lambda}=k+\frac{1}{16}\cdot\frac{k^3x^2\lambda^2}{4}+\frac{5}{256}\cdot\frac{k^5x^4\lambda^4}{16}+\&c.;$$

and hence, by putting $f=\frac{kx\lambda}{2z}$, $1=f+f^3.\frac{z^2}{16}+f^5.\frac{5z^4}{256}+f^7.\frac{119.z^6}{12288}+f^9.\frac{393.z^8}{65536}+\&c.$

from which we derive

$$f=1-\frac{z^2}{16}-\frac{z^4}{128}-\frac{35.z^6}{12288}-\frac{137.z^8}{98304}-\&c.$$

This is the limit to which f tends as x increases, and with which it coincides when x is infinitely great.

It remains now to apply the formulæ that have been investigated. If, in the equation, $\beta^2zr=\int yrdr$ (§ 8), we substitute $q+y'$ for y, we shall get

$$\beta^2z=\frac{qr}{2}+\frac{\int y'rdr}{r},$$

and the smaller the diameter of the tube, the more nearly will this equation approach to $\beta^2z=\frac{1}{2}qr$. Therefore, l being the diameter of the tube, the value of $4\beta^2z$ will be equal to ql, that is, to the product of the elevation or depression by the diameter of the tube, when the bore is very small. When mercury is contained in tubes of glass, the value of $4\beta^2z$, assigned by the English philosophers, is .015; and Laplace, from the experiments of Gay Lussac, makes it equal to .01469. There is also some uncertainty in the value of z, or the cosine of the angle of contact, which seems to be between the limits 0.75 and 0.729. We may assume $4\beta^2z=.015$, and $z=.735$, whence $\beta=\frac{1}{14}$; these numbers being recommended by their simplicity, and lying between the limits of the errors of observation.

Now, $t=\frac{x^2}{4}=\frac{r^2}{4\beta^2}=\left(\frac{l}{4\beta}\right)^2=\left(\frac{7\,l}{2}\right)^2$: the series denoted by λ, and the coefficients of the series for f, will therefore be known in numbers, and hence f may be found. Again, when $x=0$, we have $s=\frac{2z}{x.\lambda}=\frac{2z}{x}=k=\frac{q}{\beta}$; and because $x=\frac{r}{\beta}=\frac{l}{2\beta}$, we get $f=\frac{kx\lambda}{2z}=\frac{ql\lambda}{4\beta^2z}$; and hence

$$q=\frac{4\beta^2z}{l\,.\,\lambda}\times f=\frac{.015}{l\,.\,\lambda}\times f\ldots(4).$$

If we compute the value of the limit to which f approaches when l is very great, we shall find $f=0{\cdot}9635$: And hence, in the case of tubes with very large diameters, we have

$$q=\frac{{\cdot}015}{l\,.\,\lambda}\times{\cdot}9635=\frac{{\cdot}01445}{l\,.\,\lambda}\ldots(5).$$

It remains to ascertain in what cases this last formula may be safely used.

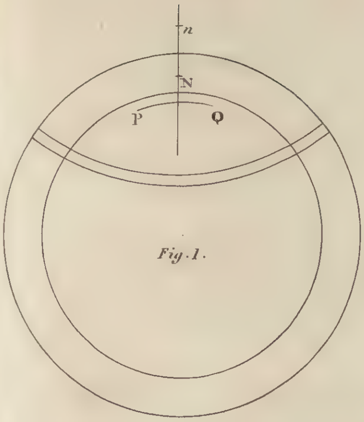
If we make l successively equal to ·3 and ·4, we shall find

$l={\cdot}3$; $t=1{\cdot}1025$; $f={\cdot}9696$; $q={\cdot}02916$;

$l={\cdot}4$; $t=1{\cdot}96$; $f={\cdot}9649$; $q={\cdot}01534$.

Now, this last value of f approaches very nearly to

CAPILLARY ACTION



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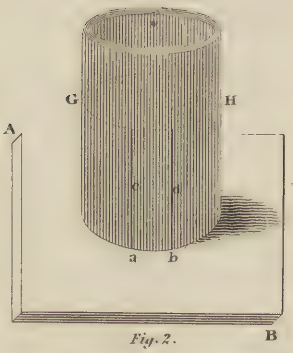
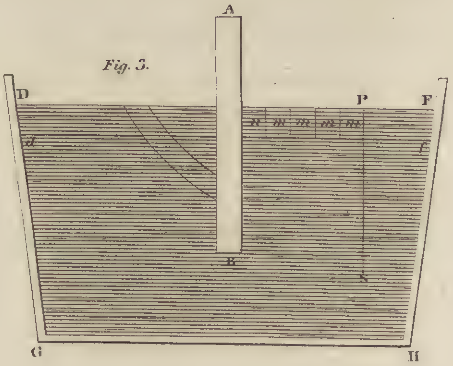


Fig. 2.



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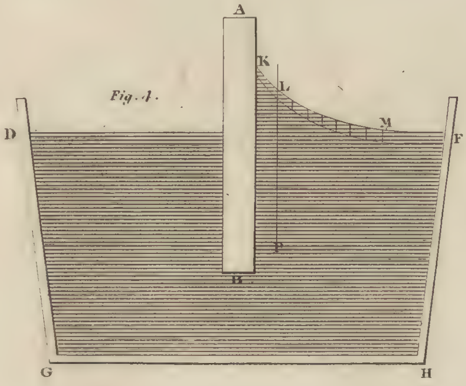

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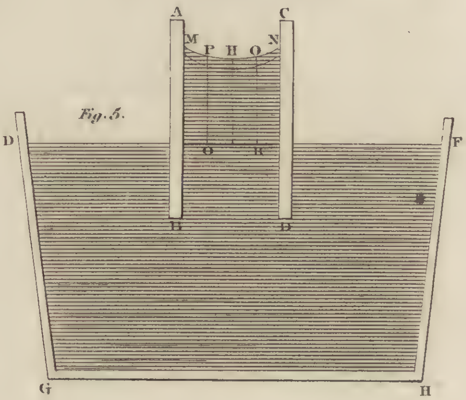

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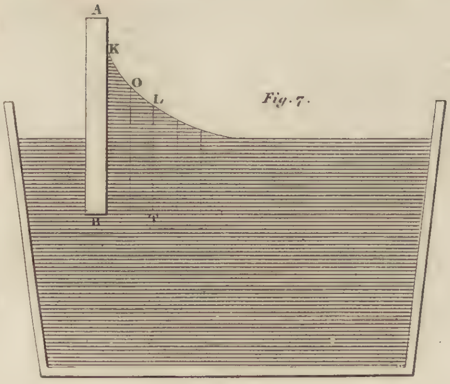

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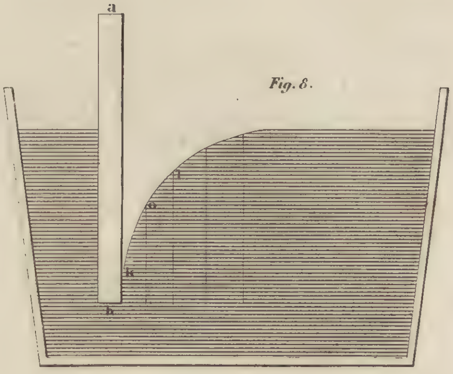

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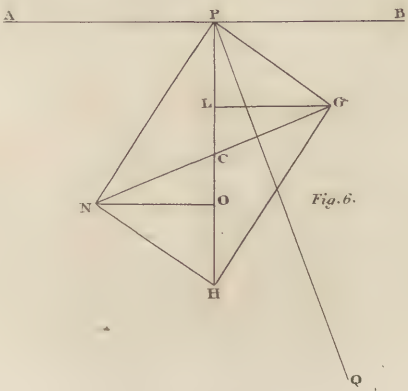

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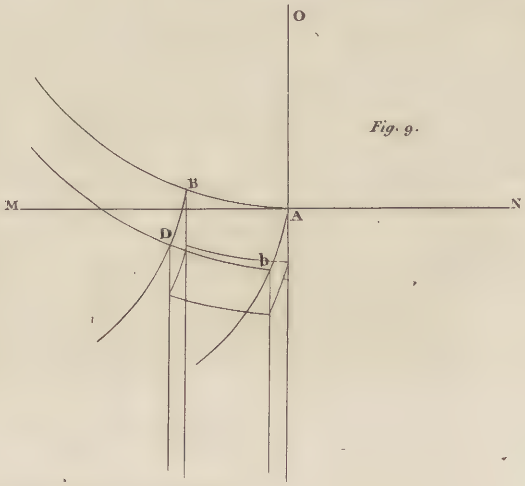

Fig. 9.

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the ultimate value; and, if q be computed by the formula (5), we shall find

$$q = \cdot 01532.$$

We may therefore use the formula (5) in all cases when the diameter of the tube is greater than four-tenths of an inch. In other cases, we must compute the depression by the formula (4), having first found f by means of the following expression, in which all the quantities too small to affect the exactness of the result are left out, viz.

$$1 = f + f^3 \times \frac{z^2}{\lambda^2} \cdot \left\{ \frac{t}{12} + \frac{t^2}{36} + \frac{11 \cdot t^3}{1440} + \frac{t^4}{1200} \right.$$

$$+ f^5 \times \frac{z^4}{\lambda^2} \cdot \left\{ \frac{t}{32} + \frac{t^2}{128} + \frac{17 \cdot t^3}{5760} \right.$$

$$+ f^7 \times \frac{z^6}{\lambda^2} \cdot \left\{ \frac{t}{64} + \frac{3 \cdot t^2}{640} + \frac{163 \cdot t^3}{161280} \right.$$

$$+ f^9 \times \frac{z^8}{\lambda} \cdot \left\{ \frac{7 \cdot t}{768} + \frac{t^2}{256} \right.$$

To compute f from this formula, assume $f = 1 - \alpha$: Then, α being always less than $\frac{1}{25}$, its square and higher powers may be neglected.

By the procedure just described, the following table has been constructed, in which all the numbers may be reckoned exact, with the uncertainty of one unit in the last place of figures.

Table of the Depression of Mercury in Glass Tubes.

Diameter of the Tube. Inches.	Depression. Inches.
0·05	0·29494
·10	·14028
·15	·08628
·20	·05811
.25	·04075
30	·02916
·35	·02110
·40	·01534
·45	·01117
·50	·00835
·60	·00443
·70	·00228
·80	·00119

(C. C.)

FONTANA (Felix), a distinguished physiologist and experimental philosopher, was born 15th April 1730, at Pomarolo, a little town in the Tyrol.

He began his studies at the neighbouring city of Roveredo, and continued them in the schools of Verona and Parma, and afterwards in the universities of Padua and Bologna. He then visited Rome, and went to Florence, where he obtained from the Emperor Francis I. who was at that time Grand Duke of Tuscany, the appointment of Professor of Philosophy at Pisa; but the Grand Duke Peter Leopold, who was also afterwards Emperor, invited him to settle at Florence, and gave him an establishment connected with his household, as *Fisico* or naturalist, and as Director of the Cabinet of Natural History, which was afterwards rendered, by his exertions, one of the principal ornaments of the city of Florence.

Fontana became the author of many well known works on physiology, natural philosophy, and chemistry. In 1757, he was engaged in an investigation, tending to confirm the doctrines of Haller respecting the irritability of the muscles, considered as a distinct quality inherent in those organs. Haller has published several of his letters as a part of his own *Mémoires sur les parties sensibles et irritables;* and the subject has afforded to Fontana the materials of several successive essays. 1. *De irritabilitatis legibus nunc primum sancitis.* Atti di Sienna, Vol. III. p. 209. (1767.) 2. *Ricerche filosofiche sopra la fisica animale.* 4. Flor. 1775. This volume contains only the *Essay on the Laws of Irritability*, stating, first, the general outline of the doctrine, then entering into the different intensity of the property of irritability, and its loss by exhaustion or by inactivity, and discussing the action of the heart, and the peculiarities of the death occasioned by electricity. 3. Another link of the same chain of investigation is found in the earlier publication *De' moti dell' iride.* 8. Lucca, 1765; showing that the contraction of the pupil depends on the effect of light falling on the retina, and not on the iris itself, and establishing an analogy between the motions of the uvea, and the semivoluntary actions of the muscles of respiration. 4. One of the most important of Fontana's works is his *Ricerche fisiche sopra 'l veleno della vipera.* 8. Lucca, 1767; containing an immense multitude of experiments, calculated to show that the poison of the viper acts by mixing with the blood, and destroying the irritability of the muscles to which it is conveyed, but that the bite of the European viper, though fatal to small animals, is scarcely ever capable of producing any immediately dangerous effects on the human frame. 5. The same matter was republished, with many additions, in the *Traité sur le venin de la vipère, sur les poisons Américains, sur le laurier-cerise, et sur quelques autres poisons.* 2 v. 4. Flor. 1781. Germ. Berl. 1787, together with some observations on the primitive structure of the animal body, experiments on the reproduction of the nerves, and remarks on the anatomy of the eye. 6. In 1766, our author published an essay entitled *Nuove osservazioni sopra i globetti rossi del sangue.* 8. Lucca; confuting the assertions which had lately been advanced by Della Torre, respecting the complicated structure and changes of form of the globules of the blood. 8. In the next year *Osservazioni sopra la ruggine del grano.* 8. Lucca, 1767, describing an animalcule like an eel, to which he attributes the rust of coin, but which has not always been found by subsequent observers in similar cases, perhaps for want of an accurate distinction of the disease intended. 9. There is also a *Lettre sur l'ergot. Journ. Phys.* VII. p. 42. 10. The *Lettera sopra le Idatidi e*

le Tenie. Opuscoli Scelti. VI. p. 108. Milan, 1783, contains an account of the hydatids which produce the symptoms of vertigo in sheep. 12. A *Lettre à* M. * * *, *Journ. Phys.* VII. p. 285, contains some remarks on the circulation of the sap in plants. 13. In an essay, *Sur le Tremella, Journ. Phys.* VII. p. 47, a zoophyte of a green colour, described by Adanson and others as a plant, is shown to consist of a multitude of little animals in continual motion.

14. Mr Fontana entered also very minutely, but with more industry than accuracy or closeness of reasoning, into the chemical novelties which occupied so much attention throughout Europe in the latter half of the last century. He seems, however, to have had the merit of first applying the discoveries of Priestley respecting the effects of the nitric oxyd to the examination of the qualities of the atmosphere, by means of the eudiometer, which is the subject of his *Descrizione e usi di alcuni stromenti per misurar la salubrità dell' aria*, 8. Flor. 1774, 4to, 1775, and is further illustrated in his (15.) *Recherches physiques sur la nature de l'air dephlogistiqué et de l'air nitreux.* 8. Par. 1776. He also observed the remarkable property that charcoal possesses, of absorbing several times its bulk of different gases. 16. In the *Ricerche fisiche sopra l'aria fissa*, 4. Flor. 1775, he is by no means equally fortunate, having fancied that the acidity of the fixed air is not essential to it, but accidentally derived from the stronger acid employed in expelling it from the earth or alkali. 17. The *Philosophical Transactions for* 1779, p. 187, contain his *Experiments and Observations on the Inflammable Air breathed by various Animals*, consisting of a repetition of Scheele's attempt to breathe hydrogen gas, which did not always create a sensation of immediate uneasiness, though it was sometimes productive of alarming consequences. 18. In the same volume, p. 432, we find an interesting *Account of the Airs extracted from different kinds of Waters, with Thoughts on the Salubrity of the Air at different places*, showing that the air afforded by water is very different under different circumstances, but that the quality of the atmosphere itself scarcely ever exhibits any variations which can be rendered sensible by chemical tests.

19. To the Memoirs of the Italian Society Fontana contributed several short essays; the first, entitled *Principi generali della solidità e della fluidità dei corpi*, Vol. I. p. 89, Verona, 1782; containing the prevalent theories of the day respecting the change in the forms of aggregation of the same substance, together with experiments on the elasticity of different gases. 20. The second is a collection of definitions, entitled *Sopra la luce, la fiamma, il calore e il flogisto*, p. 104, characterizing these supposed elementary principles according to the ideas of Bergman, Scheele, and others. 21. In a later volume, V. p. 581 (1790), we find a *Lettera del Cavaliere F. Fontana al Sign. de Morveau*, in which it is conjectured that inflammable air may be a compound of phlogiston and water, and it is observed that the white crusts of flints contain as great a proportion of pure silica as their internal parts. Our author remarks, however, that his attention had of late been much distracted from chemical pursuits by the attention required for the completion of his collection of wax models of anatomical subjects, and for the duplicates which he was preparing for the cabinet of Vienna at the request of the emperor. At a subsequent period, another series of copies of these models was ordered by Bonaparte to be sent to Paris; but it was there judged inferior to the preparations already existing in the Ecole de Medecine, which had been made under the direction of Laumonier, and Fontana's collection was sent to the university of Montpellier. He was latterly engaged for some time in the preparation of a colossal model of a man, built up anatomically of all his component parts, which were accurately represented in wood; but this elaborate design was never completed.

22. He was also the author of a few other chemical and mineralogical papers of less importance, for instance of an *Analyse de la Malachite*, Journ. Phys. XI. p. 509; and, 23. A *Lettre sur du vitriol de Magnésie trouvé dans des carrieres de gypse, en Piémont*, Journ. Phys. XXXIII. p. 309. 24. His last work is entitled *Principes raisonnés de la génération.* He was also meditating an essay on the revivification of animals; but he did not live to complete it. A collection of his works, translated into French by Gibelin, was published at Paris in 1785, entitled *Observations Physiques et Chimiques.*

Fontana had become acquainted with a great number of contemporary men of science, by having travelled in various parts of Europe, for the purpose of enriching the cabinet of which he was superintendent; the same official situation brought him into contact with all foreigners of distinction who passed through Florence in their travels; and he seems to have enjoyed a more extensive reputation than many philosophers of deeper research and more irresistible penetration. He wore the habit of an ecclesiastic, and was not uncommonly called Abbé; he was well received in the best societies, though his manners are said to have been sometimes a little at variance with the dress which he adopted. He was treated with great respect by the French generals, when they took possession of Tuscany in 1799, and hence he became the object of some suspicion upon the return of the Austrians, especially with the insurgents of Arezzo, who preceded them, and by whom he was for a short time imprisoned. His last illness was occasioned by an accidental fall in the street, on the 11th January 1805, and he died the 9th March 1806, at the age of seventy-five. He was buried in the church of the Holy Cross, not far from the tomb of Galileo. His Eloge was pronounced by Professor Mangili in the university of Pavia, the 12th November 1812. (Cuvier, *in Biographie Universelle*, Vol. XV. 8. Par. 1816.) (O. R.)

FONTANA (Gregory), a profound mathematician and natural philosopher, younger brother of Felix Fontana, was born at Villa de Nogarola near Roveredo, the 7th December 1735.

He received the first rudiments of his education at Roveredo, and continued his studies at Rome, where he entered into the *Scuole Pie*, and soon distinguished himself by his talents and assiduity. He was entrusted with the care of a part of the public instruc-

Fontana. tion in the school called the Collegio Nazareno, and was soon afterwards sent as a professor to Sinigaglia. It was here that he formed an intimacy with the Marquis Fagnani, whose example and assistance contributed very much to the advancement of his mathematical studies, to which he very soon in great measure confined his attention. He was then removed by his superiors to Bologna; but his co-operation was found more necessary for the Pious Schools, which had lately been established, at Milan; and he here obtained the patronage and friendship of the Count de Firmian, the Mæcenas of the day, who greatly encouraged the publication of his first works. From these works he acquired so much credit, that he was summoned, in 1763, to occupy the chair of logic and metaphysics in the university of Pavia, and he was appointed by Firmian director of the public library, which he founded about the same time for the university. Two years afterwards, he was advanced to the professorship of the higher mathematics, which was become vacant by the death of the celebrated Boscovich, and he filled this situation with high reputation for thirty years. He was the author of a great variety of memoirs, and did not even disdain the labour of a translator, when he thought that it could be useful to his pupils or his countrymen; but he never engaged in any single original work of great extent; for notwithstanding his habitual industry, his disposition was too volatile to allow him to confine himself long enough to any one object to effect any striking innovation in the complexion of the sciences which he cultivated. He was assiduous in the duties of his professorship, and his personal intercourse with society was extremely limited, though his correspondence with men of science was extensive. He was in the habit of writing many notes in the margin of the books that he read, and the volumes which composed his library acquired a double value from this circumstance. In April 1795, he was elected a foreign Member of the Royal Society of London. About this time his health began to decline, and his physicians considered him as having suffered from too great application to his studies. In 1796, he received great marks of respect from Bonaparte, then commanding the French army in Italy, and he was made a member of the legislative body of the newly erected Cisalpine republic. In 1800, having resigned the professorship at Pavia, he came to Milan, and was afterwards nominated one of the Electoral College of the Dotti. He was still occupied in a variety of literary pursuits, when he was attacked by a violent fever, which caused his death at Milan, the 24th August 1803. He left his manuscripts to his brother Felix, who died soon after him. An unmarried sister survived them both, and inherited the little property of her brothers, which was soon exhausted, and she was reduced to the extremity of distress. At last, finding no protection in a country to which her family had done so much honour, she became desperate, and drowned herself in the canal of Milan.

1—7. Father Fontana's principal publications were, first, seven Academical dissertations on various departments of mathematical and mechanical science, among which are the *Analyseos Sublimioris Opuscula*. 4. Ven. 1763, and the *Memorie Matematiche*, 4. Pavia, 1796. 8—23. There are sixteen short memoirs in the *Atti dell' Academia di Sienna*. Their subjects are, 8. *Astronomical Problems*, Vol. V. 1774. p. 55. 9. *Theorems relating to the Integral Calculus*, p. 69. 10. *Remarks on Incommensurable Quantities*, p. 71. 11. *On the Quantity of Air in the Atmosphere*, p. 76. 12. *On the Area of a Spherical Triangle*, p. 83. 13. *On the Binomial Theorem*, p. 88. 14. *On Accelerated Motion*, p. 92. 15. *On Projectiles*, p. 97. 16. *On a Phenomenon of Vision*, p. 103, attempting to explain the comparative brightness of an object seen by one and by both eyes. 17. *On the Effect of the Solar and Lunar Attraction upon the Height of the Barometer*, p. 116. 18. *On the Mathematical Discoveries of Cardani and Cavalieri*. 19. *An Essay on the Gradual Renewal of the Blood of an Animal, and on the Principles of Compound Interest and Discount*, Vol. V. 1781, p. 161. 20. *On the Axis of Equilibrium*, p. 173. 21. *On Curves described by the Centre of Gravity*, p. 177. 22. *On the Centres of Gravity of Hyperbolic Spaces or Figures*, p. 180. 23. *On Indefinite Equations, and on the Method of Indeterminates*, p. 184.

24—40. There are also a great variety of papers in the *Memorie della Società Italiana delle Scienze*. Among them we have, 24. *An Essay on the Descent of a Body, on a Convex Surface*, Vol. I. Verona, 1782, p. 94. 25. *Remarks on the Measurement of Light*, p. 111, in which the elegant experiments of Lambert are applied to the explanation of the uniformity of the light of the sun's disc; an essay which would have saved a great Parisian astronomer some useless labour and calculation, if it had excited his attention. 26. *On the Logarithms of Negative Quantities*, p. 183. 27. *On the Equation of a Curve on Two False Theorems, and on Harmonic Series*, Vol. II. 1784, p. 423. 28. *On the Pressure of Fluids*, p. 192. 29. *On Centrifugal Force*, p. 325. 30. *On Series*, p. 326. 31. *On Converging Series formed by the Products of the odd and even numbers*, Vol. III. 1786, p. 174. 31. *Analytical Researches on Refraction, on Perpetual Motion, on the Integration of Equations, on Collision, on the Resolution of Forces, and on the Pressure of Beams*. There is also an *Essay on Buffon's combination of Mirrors*, and another *on the Quantity of Light Reflected by a Mirror in a Given Direction*. 41—51. Five papers of G. Fontana appear in the *Memoirs of the Academy of Turin for* 1804, five in the *Biblioteca Fisica d'Europa*, and four in the *Physicomedical Journal of Pavia*. Of these one of the most interesting relates to the *Magnifying Power of Telescopes*, and is reprinted in the XVth Volume of the *Raccolta di Opuscoli*, published at Milan.

55. Of his translations, the principal are *La Dottrina degli azzardi di A. Moivre*, Pavia, 1776, with additions, said to be a piratical publication. 56. *Saggio di una difesa della Divina Revelazione, di L. Eulero*, Pavia, 1777. 57. *Dissertazione di Mosheim sopra l'opera di Origene contro Celso*, Pavia, 1778, with notes. 58. *The Hydrodynamics, and other Mathematical Works of Bossut*, Sienna, 1779. 59. *Compendio di un corso di Fisica del Sign. G. Atwood*, Pavia, 1781. 60. *Saggio sopra i principi*

della composizione storica, del Sign. Hill, Pavia, 1789, with an appendix. 61. *Discorso Preliminare agli atti della Società Linneana di Londra, del Sign. J. O. Smith*, Pavia, 1792. 62. *Sermone sul Martirio del re Carlo I. dal Dr G. Swift*, Pavia, 1798. 63. *L'Esempio della Francia, avviso e specchio all' Inghilterra, di A. Young*. Pavia, 1794.

(Guillon *in Biographie Universelle*, Vol. XV. 8. Par. 1816.) (T. U.)

Fontana || Food.

FOOD.

Our observations upon this subject may be conveniently arranged as relating to the *Selection*, *Preservation*, and *Preparation* of the various substances which are commonly used for Food.

Selection.

General Observations. Animal matters in general are safe articles of food. In regard to the higher classes, the mammalia and birds, this is universally true of those in a state of health. A few exceptions occur among the fishes, depending either upon the constitution of certain persons, who are injuriously affected by substances generally alimentary, or upon some singularity in the nature of the individual fish by which it becomes poisonous, although the species is generally nutritious and wholesome. As we descend still lower in the scale, these exceptions occur more frequently, and more species are absolutely and universally unwholesome, or furnish poisons hurtful to every constitution. In the vegetable kingdom, the alimentary vegetables form but a small proportion of the whole, and almost an equal number are absolutely poisonous, or at least injurious, except when given in small quantities, to counteract some existing disease.

Quadrupeds. Although quadrupeds, without exception, furnish articles which may be safely used as food, their flesh differs much in palatibility, and probably in its nutritious qualities. There is also no part of this class of animals that may not be, and indeed is not occasionally used as food, although the flesh, or voluntary muscles upon the limbs, trunk, and head, is by far the most considerable and important. The heart, the largest of the involuntary muscles, is also commonly eaten; and the brain, and spinal marrow or pith; all the glands, the kidneys, liver, udder, and sweetbread; the compound internal organs, the lungs, stomach, and intestines, the uterus, placenta, and even the contents of the stomach, the fat and marrow of the bones; the blood and skin are all nutritious, and some of them highly prized, and even the bones themselves can be made to furnish much wholesome nutriment. Also the milk of all quadrupeds is alimentary, and generally agreeable.

These various organs, although each of them contains several immediate principles, considered chemically, are characterized by some difference in their composition. The muscular flesh consists principally of fibrine, combined with some gelatinous mucus and ozmazome; the tendons of the muscles, on the contrary, are little else than gelatine in a very dense form. This is likewise the case with the skin, the membranes in general, and the ligaments. Brain and medullary nervous matter consist chiefly of coagulated albumen, which also, perhaps, enters largely into the composition of glands. The fat, suet, and marrow of the bones, are different forms of concrete animal oil. All these principles are digestible and nutritious, but in what comparative degree, is far from being ascertained. According to popular opinion, it is nearly inversely as their solubility in water, muscular flesh being considered to furnish the strongest aliment, and gelatinous organs the lightest. But these substances are not exactly similar in all animals, nor even in the same animal at different periods of life.

Size. In general, the flesh and other parts are coarser in proportion to the size of the animal, not only when different in kind, but in different varieties of the same species, although well grown individuals of the same variety are always better than those which have not been sufficiently nourished. Thus, the flesh of the elephant and rhinoceros have been found to be very coarse and unpalatable, while that of the rat and smaller quadrupeds is very delicate. The larger varieties of the ox and sheep, also, are inferior to the smaller, as the kyloes of the Western Islands, and the sheep of Wales and the Highlands of Scotland.

Age. The whole organs of young animals are much more gelatinous than those of the adult and aged, while these contain more fibrine and extract. Hence the flesh of young animals is more bland and tender, and yields most to the action of boiling water, while that of aged animals is more savoury, even to rankness, and is firm to toughness.

The flesh of very young animals is to our palates unpleasantly soft and flabby, qualities of which every one is a judge; but it is at no period of life, not even in the fœtal state, actually unwholesome; and, therefore, there was no rational ground for that enactment, which provided, that no butcher shall kill any calf to sell being under five weeks old. (I. James, c. 22. § 2. 25.) The fact is, that cows, large with calf, are frequently killed, and the fœtus is always sold as very young veal, and preferred by some people. By our butchers, calves are killed at from six to sixteen weeks, but they are reckoned best at ten or twelve. Lambs are generally killed at from eight weeks to half a-year.

The flesh of quadrupeds in the vigour of life is more stringy, and again becomes shorter as it advances to old age, when it becomes dry and innutri-

Selection of Food.

tious. Young animals also differ from those that are aged, in the distribution of the fat, which, in the latter, is chiefly collected in masses or layers external to the muscles; and, in the latter, is more interspersed among the muscular fibres, giving the flesh a marbled appearance, which is always a desirable property of butcher meat.

The beef of the larger breeds of oxen is in perfection when the animal is about seven years old, that of the smaller breeds a year or two sooner. Cow-beef, on the contrary, can scarcely be too young. The flesh of a young heifer is highly esteemed, that of an old fattened cow is very bad. Wedder mutton is in perfection at five years. Ewe mutton is best when about two years old. Sucking pigs are killed about three weeks old; but pork differs from other kinds of butcher meat in not requiring age to mellow it; so that, swine for pork are killed at from six to twelve months old, but for brawn, age is an advantage, or rather necessary. The buck of the fallow deer may be killed at six, but is better at eight years of age. The female, in general, being naturally more tender, and getting tough rather than mellowing by age, is sooner in perfection.

Sex.

The sex also greatly influences the quality of the flesh, that of the female being always more delicate and fine grained than that of the entire male, of which the fibres are stronger and the taste more rank. Indeed, the influence of the genital organs on the flesh of animals is very remarkable. The delicacy of the flesh, even of the female, is greatly improved by removing the ovaries, or spaying them as it is called. Every day the testes are permitted to remain, even though totally inactive as to their proper function, injures the delicacy of the veal of the bull-calf; and an animal which is not castrated until after puberty, always retains much of the rankness and coarseness of the entire male. Daubenton * directs that the male lambs should be castrated at from eight to fifteen days after their birth, although it is not usual to perform the operation until the age of three weeks, or even five or six months. But their flesh is never so good as when they are castrated at eight days. Huzard goes farther, and recommends it to be performed in a day or two after their birth, or as soon as the testes descend into the scrotum. The female lambs are also spayed occasionally in France, to render their flesh more delicate, and to improve the wool; but the operation cannot be performed until the ovaries have acquired a sufficient size to be brought out with the finger, when about three weeks old. In this country, the sow pigs, which are not reserved for breeding, are all spayed when about four weeks old; the boar pigs are castrated a week sooner. On the other hand, the males of those races in which the testes are active only at certain seasons, as the deer tribe, have the coarse rank flesh of entire males only when rutting, and at all other times they much more resemble the castrated individuals of those animals, such as the bull, which are always capable of procreating their species. Even with the ram there is a short period, when the flesh is less rank, and during the rutting season it is intolerable. Buck venison is highly esteemed, and the boar is preferred for making brawn.

Selection of Food.

Food.

The manner in which the animal has been fed has also considerable influence on the quality of the flesh. Generally the lean of fat animals is better than that of those that are poor, and perhaps an animal in a state of nature can never be too fat. Artificial fattening may, however, be carried too far, and the practice of feeding oxen on oil-cake for the market is now almost laid aside, as the beef acquired from it an unpleasant rancidity. Also unwholesome fatness, such as that which takes place in the first stage of the rot, and which, it is said upon very good authority, some butchers induce artificially, is certainly not desirable. "Several graziers and butchers, having observed, that sheep are much disposed to feed during the first stage, or four weeks after being tainted, omit no opportunity of producing it to increase their profits." † But it is not only in regard to fatness that the flesh of animals is affected by the nature of their food, for its flavour is materially altered by it, and an epicure will readily distinguish by the taste, whether mutton, of the same race, has been fed upon turnips, or upon the natural grasses of a highland farm.

The effect of the food is more apparent in pork than in any other kind of butcher meat. The fat of pigs fed on skimmed milk, though sour, is firmer, and vastly superior to that of hogs fed upon peas or meal. And Mr Jackson says, we have no pork in England or Ireland equal to that of Sardinia, where the hogs are almost wild, and fattened upon chesnuts.

Season.

The season of the year has considerable influence on the quality of butcher meat, though less than upon other kinds of aliment. Its influence depends upon the more or less plentiful supply of food, upon the periodical change which takes place in the body of the animal, and upon temperature. *In season* and *out of season* are words often vaguely applied, meaning, most commonly and correctly, the period of the year in which the substance in question is naturally best and worst, but also occasionally expressing the good or bad condition of the individual animal, without any regard to the state of the species in general; and lastly and most improperly, meaning, that it is, at that time, desired or rejected by the higher classes of society as being rare or common. The flesh of most full grown quadrupeds is in highest season during the first months of winter, after having enjoyed the advantage of the abundance of fresh summer food. Its flavour then begins to be injured by the turnips

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* *Instruction pour les Bergers, &c. par Daubenton publiée par ordre du Gouvernement, avec des notes* par J. B. Huzard, 4me Ed. augmentée. 8vo. Paris, 1810.

† *An Inquiry into the Rot in Sheep and other Animals.* By Edward Harrison, M. D. F. R. A. S. Ed. &c. 8vo. London, 1804.

given as winter food, and in spring it gets lean from deficiency of food. Although beef and mutton are never absolutely out of season, or not fit for the table, they are best in November, December, and January. Pork is absolutely bad or out of season during the summer months, and is only good in those of winter. The males of the deer tribe are in highest season from the middle of June to the beginning of September, when they begin to rut, after which they become thin and exhausted. Females in general are out of condition when they are suckling, or have lately suckled or given milk. Does which have had no kid, or were soon deprived of it, follow the general rule of castrated animals, and are in season from the middle of November to the middle of February. Their condition is not much affected during the first months of pregnancy. The season of the year when the young of quadrupeds have acquired the proper age for being used as aliment, is the period when they are in season. This is naturally in the summer months, when lamb, veal, kid, and fawns are most abundant. But breeders continue to furnish the tables of the wealthy with the two first of these at almost every season of the year, by selecting certain breeds, such as the Dorsetshire sheep, which lamb very early, or by treating them in such a way as to cause the female to come in heat at an unnatural time. In this way, lamb is procured as an article of luxury, as early as November and December; and on the contrary, by keeping the ewe on a cold and poor hill pasture, the lambing season is retarded.

Mode of Killing.

The mode of killing has considerable effect on the flesh of the animal. Most of those slaughtered for food are either bled to death, or are bled profusely immediately after being deprived of life in some other way.

The common mode of killing cattle in this kingdom is, by striking them on the forehead with a pole-axe, and then cutting their throats to bled them. But this method is cruel and not free from danger. The animal is not always brought down by the first blow, and the repetition is difficult and uncertain, and if the animal be not very well secured, accidents may happen. Lord Somerville, * therefore, endeavoured to introduce the method of pithing or laying cattle, by dividing the spinal marrow above the origin of the phrenic nerves, as is commonly practised in Barbary, Spain, Portugal, Jamaica, and in some parts of England; and Mr Jackson says, that "the best method of killing a bullock, is by thrusting a sharp-pointed knife into the spinal marrow, when the bullock will immediately fall without any struggle, then cut the arteries about the heart." † Although the operation of pithing is not so difficult but it may, with some practice, be performed with tolerable certainty, and although Lord Somerville took a man with him to Portugal to be instructed in the method, and has made it a condition that the prize cattle shall be pithed instead of being knocked down, still pithing is not becoming general in Britain. This may be partly owing to prejudice; but we have been told that the flesh of the cattle killed in this way in Portugal is very dark, and becomes soon putrid, probably from the animal not bleeding well in consequence of the action of the heart being interrupted before the vessels of the neck are divided. It therefore seems preferable to bleed the animal to death directly, as is practised by the Jew butchers.

The Mosaic law so strictly prohibits the eating of blood, that the *Talmud* contains a body of regulations concerning the killing of animals; and the Jews, as a point of religion, will not eat the flesh of any animal not killed by a butcher of their own persuasion. Their method is to tie all the four feet of the animal together, bring it to the ground, and, turning its head back, to cut the throat at once down to the bone, with a long, very sharp, but not pointed knife, dividing all the large vessels of the neck. In this way the blood is discharged quickly and completely. The effect is indeed said to be so obvious, that some Christians will eat no meat but what has been killed by a Jew butcher.

Calves, pigs, sheep, and lambs, are all killed by dividing at once the large vessels of the neck. Animals which are killed by accident, as by being drowned, hanged, or frozen, or by a fall, or ravenous animal, are not absolutely unwholesome. Indeed, they only differ from those killed methodically in not being bled, which is also the case with animals that are snared, and in those killed by hounds. Animals which die a natural death should never be eaten, as there are undeniable instances of disease, and even death being the consequence.

Animals frequently undergo some preparation before they are killed. They are commonly kept without food for some time, as if killed with full stomachs their flesh is considered not to keep well. Oxen are commonly fasted two or three days, smaller animals a day, but it is evident that the practice must not be carried too far, as the opposite effect will be produced by the animal falling off or getting feverish. It is generally understood that, in order to have veal very white, the calf is repeatedly bled largely before it is killed. But the practice does not seem to be very common. It is altogether denied by the feeders, and not confessed by the butchers. We are not, therefore, able to say what its effects would be; but Dr Lister has stated that nothing contributes more to the whiteness and tenderness of the flesh of calves than often bleeding them, by which the colouring matter of the blood is exhausted, and nothing but colourless serum remains. A much more cruel method of preparation for slaughter used to be practised, though now much less frequently, in regard to the bull. By some ancient municipal laws, no butcher was allowed to expose any bull-beef for sale, unless it had been previously

* *General Survey of the Agriculture of Shropshire.* By Joseph Plymley, M.A. 8vo. London, 1803, p. 243.

† *Reflections on the Commerce of the Mediterranean.* By John Jackson, Esq. F.S.A. 8vo. London, 1804. p. 91.

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baited. The reason of this regulation probably was, that baiting had the effect of rendering the flesh or muscular fibre much more tender; for it is a universal law of the animal economy that, when animals have undergone excessive fatigue immediately before death, or have suffered from a lingering death, their flesh, though it becomes sooner rigid, also becomes sooner tender than when suddenly deprived of life in a state of health. The flesh of hunted animals also is soon tender and soon spoils; * and it is upon this principle only, that the quality of pigs' flesh could be improved by the horrid cruelty, said to be practised by the Germans, of whipping the animal to death. Another part of the same receipt, to roast a pig wild boar fashion, consists in making him swallow, some hours before death, a quantity of vinegar aromatised with herbs. We notice this, because we think the action of vinegar given to animals some hours before death, in rendering the fibre mellow, deserves to be examined. It is a common practice in the country to give poultry a spoonful or two of vinegar sometime before they are killed, when they are to be dressed immediately. Popular practices are seldom without some foundation, and with this, the fact that acetic acid or vinegar has a peculiar chemical action upon fibrine, connects itself. The Moors in West Barbary, before they kill a hedgehog, which is esteemed a princely dish among them, "rub his back against the ground, by holding his feet betwixt two, as men do a saw that saws stones, till it has done squeaking, and then they cut its throat." (Mr Jones, *Phil. Trans.* No. 254.)

Birds.

There is no bird, and no part of any bird, nor any bird's egg which may not be safely used as food. Gmelin quotes a singular instance of some persons having been much affected after eating larks; and suspects that the flesh of the birds may have been rendered poisonous by their having fed upon hemlock-seed, which they eat with impunity. But there can be no doubt that this must be a mistake, for larks are a common and favourite food in the very country where this accident is said to have happened.

The flesh of birds differs very much in its sensible properties, not only in different kinds, but even in the different muscles of the same bird. The pectoral muscles which move the wings are whiter, drier, and more tender than those which move the legs. The tendons of the legs are also very strong, and at a certain age become bony; but the flesh of the legs, when sufficiently tender, either from the bird being young, or from long keeping, or sufficient cookery, is more juicy and savoury than that of the wings. Of a few birds, especially the woodcock and snipe, the legs are at all times preferred to the breast. In the black-cock, the outer layer of the pectoral muscles is of a dark brown colour, while the inner is white. A similar difference is observed in many other birds, and perhaps it is general in a slight degree. The muscular organs of birds differ from those of quadrupeds in their flesh never being marbled, or having fat mixed with the muscular fibres.

There is a great diversity in the flesh of the different classes of birds; but no very accurate distribution of them in this respect can be made, as, though the extremes are sufficiently marked, they run insensibly into each other. We may, however, notice, as sufficiently distinct, 1. the white-fleshed, exemplified in the common fowl and turkey; 2. dark-fleshed game, grouse, black-cock; 3. aquatic, goose, duck; and, 4. rapacious, hawks and owls. Several species of the first and third classes are domesticated, and reared in great numbers as esteemed articles of food. The white fleshed birds are very generally liked, when good of their kind, and by many are preferred to game, which, however, when sufficiently kept, is one of the greatest luxuries of an epicure's table. It then has acquired a peculiar odour, called *fumet*, and an aromatic very bitter taste, most sensible in the back. The aquatic birds, both swimmers and waders, are generally eaten, and many of them are very delicate; but, in general, they are disposed to become very fat, and often acquire a rancid and fishy taste. This is chiefly connected with the fat, and may be somewhat avoided, by skinning the bird, and removing the inside fat, before cooking. Of the rapacious birds none are eaten, partly perhaps from prejudice, and partly because those which touch carrion acquire a cadaverous smell.

The muscular fibre is coarser in the larger than in the smaller birds of the same class, and it becomes less tender as they get older. It is also much influenced by sex, although of some birds the young cock is preferred; chiefly, we apprehend, on account of its greater size and handsome appearance. By removing the sexual organs at an early age, both sexes are much improved for the use of the table, becoming larger, fatter, and more tender, as we see in the capon and poulard. The manner in which birds are fed affects both their fatness and flavour. Birds seldom get very fat in their wild state, or when domesticated, if allowed to go at large. The art of fattening poultry consists in supplying them with abundance of healthy food, and confining them. Aquatic birds, ducks and geese in particular, must be prevented from going into the water, both because they never get fat, but also acquire a rancid fishy taste.

Modes of fattening.

The fattening of fowls for the London market is a considerable branch of rural economy in some convenient situations. "They are put up in a dark place, and *crammed* with a paste made of barley meal, mutton suet, and some treacle or coarse sugar, mixed with milk, and are found to be completely ripe in a fortnight. If kept longer, the fever that is induced by this continued state of repletion renders them red and unsaleable, and frequently kills them." † But fowls brought to this state of artificial

* *Recherches de Physiologie et de Chimie Pathologique.* Par P. N. Nysten, 8vo. Paris, 1811.

† *Agricultural Report of Berkshire*, by William Mavor, LL.D. 8vo. London, 1813.

obesity are never so well flavoured in the flesh, and probably not so salubrious as those of the same species, fattened in a more natural way. The great secret of having fine pullets is cleanliness, and high keeping with the best corn.

Epicures, in all ages, have been exceedingly whimsical in the selection of certain parts of particular birds as dainties, and the ancients more so than the moderns; for although we still prize the combs of the common fowl, the trail of the woodcock, and even collect with care the dreg which drops from it in the process of roasting, the guts of the bustard, the gizzard and liver of the goose, and the feet of the duck;—we find that Roman epicures delighted in the brains of ostriches and parrots, the tongue of the flamingoe, and the enlarged liver of the goose. The last still continues among our continental neighbours to be in great request, and the providing them is a considerable branch of rural economy in some provinces. It is said, that, at Strasburgh, it is effected by actually sewing up the anus of the tortured animal, after a certain preparation; but we have not met with the barbarity set down in print, and it is perhaps not true, otherwise so striking an exemplification of Sir E. Home's doctrine, that the fatness of animals depended upon the length of their intestinal canal, and the length of time the feces were retained in it, would not have escaped his notice. The process followed in different parts of France is described at length * by Sonnini: "The object of the third method is to enlarge the liver. Nobody is ignorant of the endeavours of sensuality to cause the whole vital forces to be determined towards this part of the animal, by giving it a kind of hepatic cachexy. In Alsace, the individual buys a lean goose, which he shuts up in a small box of fir, so tight that it cannot turn in it. The bottom is furnished with a wide grating of rods, for the passage of the dung. In the fore part there is a hole for the head, and below it a small trough is kept always full of water, in which some pieces of wood charcoal are left to steep. A bushel of maize is sufficient to feed it during a month, at the end of which time the goose is sufficiently fattened. A thirtieth part is soaked in water each night, and crammed down its throat next day, morning and evening. The rest of the time it drinks and guggles in the water. Towards the 22d day, they mix with the maize some poppy oil, and, at the end of the month, it is known by a lump of fat under each wing, or rather by the difficulty of breathing, that it is time to kill it, otherwise it will die of fat. The liver is then found weighing one or two pounds, and, besides, the animal is excellent for the table, and furnishes, during its roasting, from three to five pounds of fat, which is used in the cookery of vegetables. Of six geese, there are commonly only four (and these are the youngest) which answer the expectation of the fattener. They are kept in a cellar, or place with little light, and the Roman epicures, who prized their livers, had already observed, that darkness was favourable to this kind of education, no doubt, because it prevents all distraction, and directs the whole powers towards the digestive organs. The want of motion, and the difficulty of respiration, may be also taken into consideration; the first by diminishing the waste of the system, and both by retarding the circulation in the vena portarum, of which the blood ought to become hydrogenated, in proportion as its carbon unites itself to the oxygen, which that liquid absorbs. This favours the formation of the oily juice, which, after having filled the cellular system of the body, enters into the biliary system and substance of the liver, and gives it that fatness and size which is so delightful to the palates of true gourmands. The liver thus only becomes enlarged consecutively, and the difficulty of respiration does not appear till the end, when its size prevents the action of the diaphragm."

"The leanness of geese subjected to this treatment is often mentioned; but it can only occur in those whose eyes are put out, and feet nailed down to a board, as the consequence of this barbarous treatment. Among a hundred fatteners, there are scarcely two who adopt this practice, and even these do not put out their eyes till a day or two before they are killed. And, therefore, the geese of Alsace, which are free from these cruel operations, acquire a prodigious fatness, which may be called an oleaginous dropsy, the effect of a general atony of the absorbents, caused by want of exercise, combined with succulent food, crammed down their throats, and in an under oxygenated atmosphere."

There are certain months in which each kind of bird is considered to be in season, determined by the time of their breeding, the abundance of food, or their migration. Some birds do not remain with us all the year, and are, therefore, to be valued when we can get them. The migrating birds go farther south in winter, and north in summer. They are, therefore, with us in winter or summer, according to their habits, in regard to temperature and the supply of food. Those birds which remain during summer breed here, and their young may be obtained before they fly, and while they are still delicate, as the gannet or solan goose; others, as the woodcock, rarely breed in this country, and are only got in their adult state.

There is little diversity in the mode of killing birds. Game is almost always shot, as hawking is entirely out of fashion, although, formerly, birds killed in this way were more esteemed, as, indeed, their flesh would be sooner tender. Larks are caught in winter in traps and nets, and then killed. The heads are twisted off young pigeons; but domestic birds, in general, are killed in a very unskilful and barbarous manner. The common fowl has its neck drawn, by which the spine is torn asunder at an uncertain place, and if the spinal cord be not divided, or be divided too low, the animal dies slowly, and is sometimes alive after its feathers have been plucked off. The large blood-vessels are sometimes

* *Nouveau Dictionnaire d'Histoire Naturelle.* Art. *Oie.*

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also torn across. This is an advantage, both from shortening the sufferings of the animal, and rendering its flesh whiter in consequence of the loss of blood. Turkeys are bled to death, by dividing the vessels under the tongue. The only objection to this is, that it is tedious, for probably it is not attended with much pain. Geese are killed by splitting the skull with a knife. This is sometimes very awkwardly performed, and neither any large vessels are divided, nor the nervous energy destroyed. Domestic birds are generally kept confined, and fed upon choice food for some time before they are killed, and sometimes they are crammed, or forced to eat more than they would voluntarily. They should always be kept a day without food at the last, that their crops may be empty, as food left in them is apt to taint the flesh.

Reptiles.

Of the reptiles very few are used as food, though probably rather on account of their disgusting appearance, than of their being hurtful, or even unpalatable, as some of the greatest luxuries of the table belong to this class of animals. Besides the green turtle, several other species of Testudo are eaten, especially the Græca, Europœa, and ferox. Of the lizards, the Dracœna, Amboinensis, agilis, and Iguana are eaten. The flesh of the last is said to be delicious, but unwholesome, especially to those affected with syphilis, which, however, is probably a vulgar prejudice. The Lacerta scincus is held in estimation by the natives of the east, as aphrodisiac. The eggs of the Iguana, and of most species of Testudo, even of those whose flesh is said to be bad, as of the Imbricata, are nutritious and agreeable. The flesh of the Coluber natrix is eaten in some places; and even the viper, whose bite is poisonous, furnishes a nutritious broth to invalids. Of the frogs, the Rana esculenta is a favourite article of food with our continental neighbours. The Rana taurina, or bull-frog, rivals the turtle in the opinion of our Transatlantic descendants. The Rana bombina, though a toad, is also eaten in some places as a fish. We have no doubt that many other reptiles are used as food in some countries, and we are not aware of a single instance where injurious effects have been produced by any that has been tried. Their flesh seems, in general, to be delicate and gelatinous; the fibre to resemble that of chicken or veal; and what is called the green fat of turtle, is in reality gelatinous, like the skin of calf's head, or the tendons of ox-heel, which are employed to make an imitation of it. We know little of the circumstances which influence the quality of reptiles as esculent; but the modern Apicius says, the best size of a turtle for taste is 60 lbs. to 80 lbs., which is scarcely a tenth part of the size they sometimes reach; and we may presume, that, like most other oviparous animals, they are best before they begin to lay their eggs, and out of season for some time after. Turtles often become emaciated and sickly before they reach this country, in which case the soup would be incomparably improved, by leaving out the turtle, and substituting a good calf's head.

Fish.

In some places, fish constitutes the sole or chief food of the people, hence called Ichthyophagi, and almost everywhere it is in request. In Siberia, dried fish is used instead of bread. The Laplanders make a bread of fish bones, and the Negroes of the west coast of Africa dry a species of sprat, and beat it in wooden mortars to a paste, which keeps all the year, and is eaten with rice or corn. Putrid fish is even the favourite and ordinary food of some tribes. Fish, however, is not so universally a safe aliment as the two preceding classes of animals. For although no species is generally unwholesome, yet, in some situations, individuals of many different species are absolutely poisonous, while others of the same species, and not to be distinguished by any certain external characters, at the same place, and in the same season, are innocent and nutritious, which render the eating of fish in such countries not free of danger.

Poisonous Fish.

The subject of poisonous fishes is still involved in great obscurity, although so important to those exposed to suffer from them. It is not peculiar to any genus, species, or distinct variety, but occurs in individuals only, and those of several genera of very different classes, such as Clupea, Perca, Boracinus, Sparus, Coryphoena, Scomber, Muraena, Balistes, Tetrodon, and Cancer. Except the Bogmarus Islandicus, which is reputed poisonous by the Icelanders, because the crows refuse to eat it, poisonous fish occur only in tropical seas. It is only at certain seasons, however, that any poisonous fish occur; as in the Carribbean sea in May, June, and July, after having spawned. Their deleterious effects are ascribed by some to the fish feeding on poisonous substances, as on copper banks, medusae and holothuriae, or the manchineel apple. The poison is supposed to exist in the gall; and it is said that, if the peritoneum and all the entrails be speedily and dexterously removed, the flesh may always be eaten without danger. A fish is suspected when it is of an unusually large size, or is destitute of the natural fishy smell, or has black teeth; or when silver or an onion boiled along with it becomes black. But all these tests are uncertain. The poisonous quality is also said to be destroyed by salting the fish, or drinking along with it sea water, or the ripe juice of the lime, sugar cane, or sweet potatoe.

Some ancient, as well as modern naturalists and physicians, consider the roe of the barbel as unwholesome when eaten; others think it is hurtful only at certain seasons, to certain individuals, and when eaten in excess; and lastly, some declare the whole allegations to be erroneous and unfounded. Bloch, the great ichthyologist, and Bosc, both assert that they and others have eaten it without any inconvenience. But Dr Crevelt of Bonn has published cases which leave little doubt that, in some cases, the roe is actually injurious, although the flesh of the same individual was eaten with impunity.

The ancients had many prejudices in regard to the wholesomeness or unwholesomeness of certain fishes. The Egyptian priests were forbidden to eat fish of any kind, under the idea that it increased the sexual appetite, or that it was a cause of the leprosy. For the latter reason, the people were forbid to eat any fish not covered with scales. Moses adopted the same principle: "Whatsoever hath fins and scales in the waters, in the

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seas, and in the rivers, them shall ye eat." "Whatsoever hath no fins or scales in the waters, that shall be an abomination unto you." (Levit. ch. xi. 9, 12.) Numa made a law for the Romans much to the same effect; but it did not continue in force, as we find the lamprey and sturgeon among the luxuries of the Emperors; and such fish now form the chief support of the people in some districts, without being followed by any bad effect.

Fishes, however, present an infinite variety in regard to their fitness as articles of food, in the colour and texture of their muscles, and in being more or less gelatinous, fibrous, or oily. The muscles of many fish, with the exception of the heart, are quite white, and, in general, when the fish is good, they become opaque when cooked. When they remain semitransparent and bluish after sufficient boiling, they are not in season. Of some fishes the flesh is a pale red at certain seasons, and the higher the colour of these kinds, the more are they esteemed. Of most fishes the muscles are disposed in flakes, and, when in perfection, there is, when cooked, a layer of white curdy matter between them, resembling coagulated albumen. Some other fishes, chiefly those that are flat, or eel-shaped, or without scales, have a fibrous flesh, not divisible into flakes. The liver of the fish tribe abounds with oil, and of many species the flesh is mixed or covered with oil or fat, as the eel or salmon; but of many others, the flesh seems to be totally free from it, as all the varieties of the cod, haddock, whiting, and the flat fish.

Almost every soft part of fishes is nutritious, and occasionally eaten. The great bulk of the animal consists of the muscles of voluntary motion, covering the spine and its appendages. But of some fishes, as turbot, ling, &c. the pulpy gelatinous skin is esteemed. Codsounds are the swimming bladders of the large cod; and they are preserved separately, and transmitted to the capital for the gratification of our epicures. In the fresh fish, the tongue, palate, and lips, although too soft for most people, are preferred by some. The roe of most fishes is eaten, and that of some constitutes a principal article of national food. Caviare is the preserved roe of the sturgeon. The melt or soft roe of the herring is eaten by many. The liver of the burbot is very large, and is much esteemed. The enormous *vas deferens* of the male cod fried is one of the best garnishes for that fish; and some of the smaller and more delicate fishes are eaten whole, with the exception of the head.

So far as we have knowledge of the effect of sex upon the nutritive qualities of fish, the male or melter is much preferred, as in the herring and salmon. In spring, the male only of the lump fish, or cockpadle, Cyclopterus lumpus, is eaten. (Mr Neill, *Wernerian Transactions*, Vol. I. p. 548.) Later in the year, the female is nearly of equal quality.

Castration.

The castration and spaying of fish was at one period practised, but only to a very limited extent, and is now entirely laid aside. It was first performed by Mr Tull of Edmonton, who seems to have been a fishmonger. The earliest notice of his discovery is in the *History of the Royal Academy of Sciences of Paris for* 1742, in the extract from a letter to M. Geoffroy, from Sir Hans Sloane, in which he states that he had seen the operation performed on two small carps. A more detailed account of an improved process was afterwards published in the *Philosophical Transactions* for 1754. Mr Tull's object at first was to prevent the excessive increase of fish in some of his ponds, where the numbers did not permit any of them to grow to an advantageous size. But, from castration, the increase was not only prevented, but the castrated fish grew much larger than their usual size, were more fat, and, what was no trifling consideration, were always in season. The operation was performed by making a longitudinal incision from between the two fore fins almost to the anus of the fish, laying aside the intestines first on one side, and then on the other, and dividing transversely the oviduct or vas deferens. The wound in the integuments was then stitched up; and without farther attention, few fish died of the operation. The operation was most easily performed in May, when the ovaries and spermatic vessels are full. In France, Baron de la Tour operated so successfully, that out of 200 carps he did not lose four. It was also tried in Germany, and it was observed, that those fish, castrated in spring, were in autumn still smaller than the others; but that in the following spring they were large and fat, but some people thought not so well tasted.*

Age of Fish.

In regard to the age of fish as affecting their fitness for food, we are inclined to think, that the adage "better small fish than no fish," implying, that the larger they are the better, is not always correct. For although a well grown and well nourished individual is always finer than one not in so good condition, and although some fishes, naturally soft, may become firmer as they grow older, yet many fishes are certainly more delicate when of a smaller size, probably from being younger. Cod is generally preferred large, but we have seen very large cod very coarse. The haddock is certainly better when it does not exceed a middling size; and the whole skate tribe are apt to get coarse and strong as they get large. Ausonius says, the bream is the only animal which improves by old age:

> Tu melior pejore aevo, tibi contigit uni,
> Spirantum ex numero, non inlaudata senectus.

The flavour of fish is very much influenced by the nature of their food, independently of their apparent condition; and hence there is the greatest difference of the fish on different coasts, or in different rivers and lakes. In general, sea-fish are best where the water is deep, and strong or salt, and where the shore

* *Account of* Mr Samuel Tull's *Method of Castrating Fish. Philosophical Transactions*, Vol. XLVIII. 4to, London, 1755, p. 370. *Also* Krunitz, *Oekonomisch-technicologische Encyclopedie*, 13ter Th. 8vo, Berlin, 1786, p. 491.

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is bold and rocky. Hence the cod and ling caught near the shores, aestuaries and bays, are greatly inferior in quality to fish caught off headlands, in strong currents, and deep water. Of the river-fish, those which are found in clear rapid streams, with a rocky or gravelly bottom, in a mountainous country, are indeed less fat, but better tasted; and hence the salmon of the Elbe and Rhine are more valued than that of the other continental rivers. The Thames salmon, however, is preferred in the London market to all other, and some epicures pretend to be able to distinguish by the taste, when it comes from a favourite reach of the river. Certain however it is, that fish caught in slow running waters, with a muddy bottom, such as occur in flat countries with a rich soil, though generally larger and fatter, are very inferior in the more essential points of flavour and firmness. Also, the fish of large deep lakes, with a gravelly bottom, is much preferable to that of small, shallow, and muddy ponds or tanks. The bad qualities of fish in stagnant waters, into which the filth of cities was emptied, did not escape the notice of Galen. Fresh water fish, bred in muddy bottoms or foul water, are sometimes freed from the unpleasant earthy taste by keeping them for some time in ponds of clear water, with a gravelly bottom.

Season.

The season of the year has the most marked effect upon the quality of fish, as connected with their spawning. In general, fish of every kind are best some time before they begin to spawn, and are unfit for food for some time after they have spawned. This, however, is not sufficient to prevent those who have an easy opportunity from catching and eating fish in this state, and the Legislature has found it necessary to fix the periods during which salmon-fishing is legal. When the salmon is in the sea, and about to enter the rivers for the purpose of spawning, it is infested with a parasitical insect, which adheres to every part of the body, and dies and drops off after the fish has been for a short time in fresh water. In this state it is in the highest perfection, the flesh is firm, red, and delicious, their form elegant, and their colours beautiful. On first entering the river, the silvery colour of the sides is very slightly marked with spots; but when it has remained long in fresh water, this colour decays, and the spots become much larger, darker coloured, and more obvious. At the time of spawning the sides of the fish get of a very red colour, and when the spawning is over the white colour entirely disappears, the belly becomes livid, and the sides are streaked all over with a sooty or black colour; and in this state the salmon are termed in the Acts of Parliament red and black fish. The rays of their fins are all at this time jagged or torn, a great part of their scales rubbed off, and their gills infested with parasitical worms. In Ireland, where great freedom is used in destroying salmon during and after spawning season, the eating of the fish at that time has been often, and in many places, found to be productive of much disease and mortality; and the same is probably sometimes the case in Scotland, although not so much observed as to be generally known, but a very marked instance is mentioned by Dr Walker. *

Other fish are probably unwholesome after spawning, but they are seldom caught in that state. Young fish, not come to the age of spawning, are in season all the year.

In regard to their *habitat*, or situation where they live, fishes may be divided into three families; 1*st*, Those which live entirely in salt water, as the cod and herring; 2*d*, Those which live entirely in fresh water, as various species of the cyprinus; and 3*d*, Those which live alternately in salt and fresh water, as the salmon and sturgeon. The comparative esculent qualities of each depend upon a great variety of circumstances; but of the last class, it may be remarked, that as they enter the rivers for the purpose of spawning, they are in greatest perfection when they are proceeding up the rivers, and are quite out of season when returning to the sea.

Fish seldom undergo any preparation for killing, nor is there any attention paid to the mode of depriving them of life. Most commonly they are killed as soon as caught, and frequently by merely taking them out of the water. Sometimes, when large, the fishermen strike them upon the head, or tear asunder the branchial vessels. The Dutch carry all their fresh fish alive to market, and when any die, previous to being sold, they are exposed in a different manner, and at an inferior price. This practice no doubt insures fresh fish, but, if certainly fresh, they will be in greater perfection if killed immediately when caught, than preserved alive for any time in an unnatural situation.

Crimping.

To improve the quality of fish they are sometimes subjected to the process called crimping. It has been examined by Mr Carlisle, to whom we are indebted for the following facts: "Whenever the rigid contractions of death have not taken place, this process may be practised with success. The sea fish destined for crimping are usually struck on the head when caught, which it is said protracts the term of this capability, and the muscles which retain this property longest are those about the head. Many transverse sections of the muscles being made, and the fish immersed in cold water, the contractions called crimping take place in about five minutes, but, if the mass be large, it often requires thirty minutes to complete the process."[1] The crimping of fresh water fishes is said to require hard water, and the London fishmongers usually employ it. Mr Carlisle found that, by being crimped, the muscles subjected to the process have both their absolute weight and their specific gravity increased; so that it appears, that water is absorbed, and condensation takes

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* *Prize Essays and Transactions of the Highland Society of Scotland*, Vol. II. Edin. 1803. *Essays on the Natural History of Salmon*, by the Reverend Dr Walker, Professor of Nat. Hist. Univers. Edin., A. Drummond, Esq. and Messrs Mackenzie and Morrison.

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place.* It was also observed, that the effect was greater in proportion to the vivaciousness of the fish. From these observations it appears, that the object of crimping is first to retard the natural stiffening of the muscles, and then, by the sudden application of cold water, to excite it in the greatest possible degree, by which means it both acquires the desired firmness, and keeps longer. We may also here observe, that rigidity is a certain mark that the fish is perfectly fresh, and has not begun to spoil.

Mollusci.

The *Mollusci* do not furnish a very extensive source of human food, and they are not without danger. Of those without shells, only the *sepiæ* and some *ascideæ* are eaten, but not generally. The limpet, *Patella vulgata*, the periwinkle, *Turbo littoreus*, and whelk, *Murex antiquus*, are eaten, boiled, by the common people in this country; and the *Helix pomatia* is reared and fattened with great care in some cantons of Swisserland, as an article of luxury, and exported pickled. Many other snails are eaten by the poor in various districts, and we do not know that any is absolutely hurtful. The bivalves, in like manner, are generally wholesome, and some of them have long been among the *deliciæ gulosorum.* The Romans sent to Britain for oysters, and the British epicures delight in the *Pholas dactylus* of the Italian shores.

The crustaceous shell-fish of sufficient size are very generally esculent, and some of them are greatly esteemed, and others abundant. These chiefly belong to the family of *Cancer*, and comprehend both short-tailed and long-tailed species, the velvet crab, one of the most esteemed in France, the *C. maenas*, eaten by the poor in London. *C. pagurus*, the black-toed crab, *C. ruricola*, the land crab of our Transatlantic islands, *C. gammarus*, the lobster, *C. astacus*, the craw fish, *C. crangon*, the shrimp, and *C. squilla*, the prawn, besides others not known in this country.

Few insects are used in food. The locust is, however, consumed in great quantities, both fresh and salted, so as to afford some compensation for the ravages it commits. The Moors in West Barbary esteem, as delicious, honeycomb with the young bees in it, while they still resemble gentles, but Mr Jones says, that they seemed insipid to his palate, and sometimes gave him the heart-burn.

Vegetables.

Although the vegetable kingdom furnishes the human race, even those who eat flesh most freely, with the greater part of their food, yet there are many more exceptions to the fitness for human food in the vegetable than in the animal kingdom, both from mere indigestibility or defect of nutritious qualities, and from being directly deleterious and hurtful. The selection of vegetable food, when we depart from that which is familiar and known, is, therefore, more difficult, and subject to uncertainty. There is, however, a certain analogy between the action on the animal economy among vegetables which resemble each other in external form, or in their botanical characters. The arrangement, therefore, of vegetables into natural groups or families, is calculated to assist us in judging of the uses, medicinal or esculent, of untried vegetables. †

All parts of vegetables are used as food,—roots, stalks, or shoots,—leaves, flowers, fruits, seeds, and the whole plant. The seeds of the *Cerealia*, the *Gramineæ* of modern botanists, furnish the most important part of our food in almost every climate. Their mucilaginous shoots also support that class of animals hence called graminivorous, whose flesh is most generally eaten; and the abundance of different species in all varieties of climate, and the absolute identity of their nature, is the cause, as De Candolle well observes, that these animals may be transported and naturalized from one end of the world to the other.

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Preservation.

As the supply of food is always subject to irregularities, the preservation of the excess obtained at one time to meet the deficiency of another would soon engage the attention of mankind. At first this method would be simple and natural, and derived from a very limited observation; but, in the progress of society, the wants and occupations of mankind would lead them to invent means by which the more perishable alimentary substances of one season might be reserved for consumption at another, or the superfluous productions of distant countries might be transported to others where they are more needed. The principles of this most important art have been no where better explained than in the 45th Number of the *Edinburgh Review*, by an eminent vegetable physiologist. We have only to regret that he did not fill up the plan with a sketch of which he has concluded the article.

In general, organic substances, as soon as they are deprived of life, begin to undergo certain chemical changes, more or less rapidly, and of different kinds according to their nature. Although the modes of change, especially in the first stages, are almost as numerous as the substances themselves, yet ultimately they terminate in one or more of the principal kinds of fermentation described by chemists. To each of these, besides the presence of an organic substance capable of undergoing it, several conditions are requisite, of which the principal are a certain temperature, a certain degree of moisture, and the access of air; and it is by obviating or modifying these conditions that we are enabled to prevent or regulate the natural fermentation. The kind of fermentation which substances undergo depends upon their composition, and it may be generally remarked, that those which do not contain a considerable proportion of azote are incapable of the putrefactive fermentation, but pass through the vinous, acetous, and destructive, successively. On the

* The Croonian Lectures on muscular motion, by Anthony Carlisle, Esq. F.R.S. *Philosophical Transactions*, for 1805, 4to, London, 1805, p. 23.

† *Essai sur les Propriétés Médicales des Plantes, comparées avec leurs formes exterieures et leur classification naturelle.* Par M. A. P. De Candolle. 8vo, Paris, 1816.

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other hand, those which contain a large proportion of azote are capable only of the putrefactive and destructive; but there are many substances containing a small proportion of azote, in which both kinds of fermentation are combined.

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A great proportion of vegetables are used in a recent state, and, in this case, the sooner after they are gathered the better. Vegetables, in general, should be kept apart, for, if laid in contact, in a very short time they impart their peculiar flavours to each other. Leeks or celery will quickly spoil a whole basketful of cauliflower or the finer vegetables. Another general rule is, that they should not be kept in water, nor even washed or refreshed by sprinkling them with water, till they are to be used, as the flavour is thereby greatly injured; but if, by having been cut or gathered some time, they have become flaccid, it is absolutely necessary to restore their crispness before cooking them, otherwise they will be tough and unpleasant. This is to be done, when the size of the vegetable admits of it, as cauliflower, sallad, celery, &c. by cutting off a piece of the stalk and setting the fresh surface, thus exposed, in water, which will be absorbed; in other cases the whole vegetable must be immersed in water.

Most vegetable substances being more or less succulent, their full proportion of fluids is necessary for their retaining that state of crispness or plumpness which they have when growing. On being cut or gathered the exhalation from their surface continues, while, from the open vessels of the cut surface, there is often great exudation or evaporation, and thus their natural moisture is diminished, and the tender leaves become flaccid, and the thicker masses or roots lose their plumpness. This is not only less pleasant to the eye, but is a real injury to the nutritious powers of the vegetable; for in this flaccid and shrivelled state its fibres are less easily divided in chewing, and the water which exists in vegetable substances, in the form of their respective natural juices, is directly nutritious. The first care in the preservation of succulent vegetables, therefore, is to prevent them from losing their natural moisture. In regard to the tender succulent vegetables this is not altogether possible; because there is a constant exhalation from their surface, while the supply of moisture is cut off. The principle of preserving them, then, is to retard and diminish the exhalation. This is most effectually done by protecting them from the action of the sun's rays, from the air, and from heat. Even growing vegetables become flaccid in a hot sun, because the exhalation is then greater than the supply; and exposure to the sun is absolutely ruinous to all the more delicate vegetables. The operation of heat and air is slower but similar. Succulent vegetables should, therefore, be kept in a cool, shady, and damp, place. They should also be kept in a heap and not spread out, which greatly influences their shrivelling. But when accumulated in too large heaps for any length of time, they are injured in another way, by their heating, as it is called, which is the commencement, in them, of a chemical change, or fermentation, which altogether alters their nature. In many cases the chief business is to prevent evaporation. Potatoes, turnips, carrots, and similar roots, intended to be stored up, should never be cleaned from the earth adhering to them, because the little fibres, by which it is retained, are thus wounded, and the evaporating surface is increased. They should also be wounded as little as possible, and the tops of turnips and carrots should be cut off close to, but above, the root. The next thing to be attended to is to protect them from the action of the air and of frost. This is done by laying them in heaps, burying them in sand, or in earth, immersing them in water, or covering them with straw or mats. The action of frost is most destructive, as, if it be considerable, the life of the vegetable is destroyed, and it speedily rots. A less degree of frost induces a singular but hurtful change upon the potatoe, by converting part of its starch, or mucilage, into sugar. The germination of seeds also convert their starch into sugar, as is exemplified in the malting of barley. But, even after this change has been induced, if the substance be thoroughly dried in a kiln or otherwise, it will still remain a long time without decay.

Fruits.

The maturation of fruits, although not thoroughly examined, seems to be a change of the same kind, that is, sugar is formed at the expence of the other principle of the unripe fruit. The maturation of fruits is intimately connected with a certain species of decay, as exemplified in the firmer fruits. The rotten part of many pears is remarkably sweet, and the saccharine matter does not begin to be formed in the medlar until its decomposition be far advanced. In other instances, as in the apple, the decayed part is intensely bitter; and the softer juicy fruits grow mouldy and offensive. The art of preserving fruits consists in being able to prevent and retard these changes. A certain proportion of moisture seems to be necessary for their decay; and hence, by careful exsiccation, grapes are converted into raisins, plumbs into prunes, and figs are dried. But by carefully excluding them from the air, they may even be preserved without dissipating their natural moisture. Thus currants, cherries, and damsons, gathered perfectly dry and sound, may be put into bottles, closed with cork and rosin, and buried in a trench, with the cork downwards. Fine bunches of grapes may also be preserved in bags, by closing the cut end of the stalk with wax, which prevents the escape of moisture, or they may be packed in very dry bran or sand. Some may even be preserved by being kept immersed in water. This is constantly practised in regard to the cranberry, and sometimes succeeds with apples.

The preservation of fruit is in many countries an object of much importance. In some, the great object is to preserve the fruit in as natural a state as possible. This is particularly the case in regard to winter apples, and pears, and grapes. The time for gathering fruits depends upon their exposure, and the manner of gathering them influences their keeping. After having prepared the fruit-room, a fine day is to be chosen, and, if possible, after two or three preceding days of dry weather, and, about two in the afternoon, the fruit is to be gathered, and deposited in baskets of a moderate size, taking care that none of it receive any bruise or blemish, for the injured part soon rots and spoils the sound fruit in

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contact with it. As the summer fruits ripen more quickly after they are pulled, only a few days consumption should be gathered at once, by which means we can enjoy them for a greater length of time. Autumn apples and pears should be gathered eight days before they are ripe; and, indeed, some kinds never become fit for eating, on the tree. If they have been necessarily gathered in wet weather, or early in the morning, they should be exposed a day to the sun to dry, and they should on no account be wiped, which rubs off the bloom, as it is called, which, when allowed to dry on some fruits, constitutes a natural varnish, closing up the pores, and preventing the evaporation of the juices. They should not be laid in heaps, which causes them to sweat, and undergo a slight fermentation; for fruit thus treated, if it does not spoil, gets dry and mealy; and hence, in this country, the ordinary apples, imported from England and the Continent, are inferior to our own. The principal requisites for a good fruit-room are great dryness, and equality of temperature, and the power of excluding light. Some curious persons preserve fine pears, by passing a thread through the stalk, of which they seal up the end with a drop of sealing wax, enclose each separately in a cone of paper, and hang them up by the thread brought through the apex. Experience has also proved, that grapes keep better when hanging than when laid upon a table. The cut end should be closed with wax, which prevents exhalation. Some hang them by the stalk, others by the point of the bunch, as the grapes are thus less pressed against each other; but it is in both cases necessary to visit them from time to time, and cut off, with a pair of scissors, every berry that is mouldy or spoiled.

More artificial modes for preserving grapes in a succulent state are sometimes used, and become necessary for their transportation to distant countries. They are often packed with bran and saw-dust, and Apicius says, they may be preserved in barley. The same classical gourmand was well acquainted with the use of water in preserving the grapes in their natural state. "Take grapes from the vine without wounding them. Boil rain-water down to a third, and put it into a vessel into which you also put the grapes. Close the vessel with pitch and gypsum, and place it in a cool situation, to which the sun has not access, and when you please you will have green grapes. The water may be given to sick persons as hydromel." The boiling of the water so long is unnecessary, as a much shorter time would be sufficient to expel the air, which is probably the manner in which it has some effect. The water will acquire a slight acidity from the grapes; and hence it was given, sweetened with honey, as a pleasant drink to the sick.

Preservation of Animal Substances.

Animal substances in general, when deprived of life, have a natural tendency to undergo the putrefactive fermentation. Before this is established, they pass through a series of successive changes, which are intimately connected with our subject. After death, the bodies of animals cool more or less rapidly, according to the temperature and conducting power of the air, or other substances with which they are in contact. In fact, they do not differ in this respect from an equal mass of any other matter, heated artificially to the same temperature, and having the same conducting power. As this, however, is very weak, the bodies of animals cool very slowly after death.

For some time after death, the muscular parts of animals continue to suffer contraction, followed by relaxation, when stimulated, as by the point of a needle, or the application of Galvanism. But this irritability or organic contractility, as it is termed by some modern physiologists, gradually disappears in the different organs, and commonly in the muscles of the trunk, before those of the limbs. It is also observed, that, in the different classes of animals, the duration of the irritability is inversely as the energy of muscular action which they exhibit during life. It is strongest and most durable in animals which are suddenly killed when in high health, and is weak and evanescent in those which die of lingering diseases, or from fatigue.

After the irritability has entirely ceased, the muscles begin to become rigid, first those of the trunk, and then those of the limbs. Its duration is inversely as the time of its commencement; and it is longest of beginning, but is greatest and lasts longest in those animals which are suddenly killed when in high health. It appears very quickly, and lasts a short time only, in animals which die of exhaustion, or from fatigue. In whatever attitude the limbs are placed at its commencement, they continue; and hence butchers take care to dress properly the carcases of animals while yet supple. For after rigidity has commenced, if the position of the limb be forcibly changed, it is destroyed, and the joint becomes permanently supple. Also muscles which are frozen, when rigid, are extremely supple as soon as they are thawed. Rigidity is perhaps never developed in animals frozen to death.*

While this rigidity continues, the flesh of animals is hard and stringy, and, so far as the palate is concerned, not yet fit for the table, although fully nutritious, and in perfection for making soup. After the rigidity has totally ceased, animal flesh is not long of experiencing the commencement of those chemical changes, which terminate in putrefaction; and it is of the utmost importance, in domestic economy, to take care that all large joints be in this intermediate state when they are cooked; for no skill in the culinary art will compensate for negligence in this point, as every one must have often experienced to his great disappointment. Meat, in which we are able to detect the slightest trace of putrescency, has reached its greatest degree of tenderness, and should be used without delay; but before this period, which in some kinds of meat is offensive, the degree of inteneration may be known by its yielding readily to the pressure of the

* *Recherches de Physiologie et Chimie pathologiques*, par P. N. Nysten. 8vo, Paris, 1811.

finger, and by its opposing little resistance to an attempt to bend the joint. Poultry also thus part readily with their feathers, and it would be advisable to leave a few when the bird is plucked, in order to assist in determining their state. "No man who understands good living will say, on such a day will I eat that turkey, but let him hang it up by four of the large tail feathers, and when, on paying his morning visit to the larder, he finds it lying upon a cloth, prepared to receive it when it falls, that day let it be cooked." But as we cannot always choose our time for eating the joints in our larder, we must, in providing them for a particular day, estimate that they will then be in a proper state, or, if necessary, endeavour to hasten or retard it. By experience, we acquire some knowledge of the length of time for which the different kinds of meat should be kept, although it is subject to great variations, depending upon the temperature, moisture, and ventilation of the place where it is kept, upon the kind of meat, the age of the animal, and upon peculiarities in the individual not understood.

The chief means of preventing the fermentation of organic substances are reduction of temperature, desiccation, exclusion of air, and the action of certain substances called antiseptic. Although most commonly employed in combination with each other, we shall briefly explain the principles upon which they act singly, and then notice their practical application in reference to the animal and vegetable kingdoms.

A moderate reduction of temperature acts by retarding vital and chemical action, and a reduction, capable of freezing the juices and fluids of organized bodies, by destroying vitality, and converting the water present into ice, and thus removing a condition essential to chemical action. Many vegetable, and some animal substances, such as eggs, possess what may be called latent life, and so long as this continues they resist fermentation. A very low temperature puts an end to it, while a high temperature calls it into action, after which it cannot be suspended without destroying it altogether, and thus it is longest preserved in a temperature just a little higher than the former. An egg which has been frozen is killed, and rots soon after being thawed. On the other hand, by incubation, or an equal degree of heat, the life of the chick becomes active, and cannot again be checked with impunity; while, at a moderate low temperature, the latent life of an egg continues a great length of time, ready to be excited into action when placed in favourable circumstances, and resisting the natural tendency to chemical change. The same observation nearly applies to vegetables. Succulent roots, for example, can be long preserved in a moderately low temperature, but if it be raised they begin to shoot; or if it be reduced too much, they die and soon rot.

On dead organic substances, a reduced temperature acts by retarding or preventing chemical change.

The preservative effects of cold are of the utmost importance to the northern nations, by enabling them to store up a sufficient stock of all manner of provisions for their winter consumption, and to receive supplies from a great distance. It is thus, that veal frozen at Archangel is brought to Petersburgh, and the markets of Moscow present immense stocks of hogs, sheep, and fish. The same advantage is taken of the cold in Canada, and all other countries where the frost is sufficiently steady.

Substances, so long as they are hard frozen, probably undergo no chemical change, of which the most striking proof was afforded by the body of an animal, probably antediluvian, being found imbedded in a mass of ice at the mouth of the Lena; but in the act of freezing, or of the subsequent thawing, some alteration is produced, which affects the nature of the substance. This may be either merely mechanical, from the particles of ice during their formation, tearing asunder and separating the fibres; or chemical, by destroying the intimate union of the constituents of the fluids, as in wine injured by having been frozen; or by causing new combinations, of which we have an example in the sweetness acquired by the potatoe.

Captain Scoresby, contrary to popular belief, states, that "the most surprising action of the frost, on fresh provision, is in preserving it a long time from putrefaction, even after it is thawed and returns into a warm climate. I have," says he, "eaten unsalted mutton and beef nearly five months old, which has been constantly exposed to a temperature above the freezing point for four or five weeks in the outset, and occasionally assailed by the septical influences of rain, fog, heat, and electricity, and yet it has proved perfectly sweet. It may be remarked, that unsalted meat that has been preserved four or five months in a cold climate, and then brought back to the British coasts during the warmth of summer, must be consumed very speedily after it is cut into, or it will fail in a day or two. It will seldom, indeed, keep sweet after being cooked above twenty or thirty hours."

In freezing animal substances, for the purpose of preserving them, no other precaution is necessary than exposing them to a sufficient degree of cold. "Animal substances," says Captain Scoresby, "requisite as food, of all descriptions (fish excepted), may be taken to Greenland and there preserved any length of time, without being smoked, dried, or salted. No preparation of any kind is necessary for their preservation; nor is any other precaution requisite, excepting suspending them in the air when taken on shipboard, shielding them a little from the sun and wet, and immersing them occasionally in sea-water, or throwing sea-water over them after heavy rains, which will effectually prevent putrescency on the outward passage; and, in Greenland, the cold becomes a sufficient preservation, by freezing them as hard as blocks of wood." "The moisture is well preserved by freezing, a little from the surface only evaporating; so that if cooked when three, four, or five months old, meat will frequently appear as profuse of gravy, as if it had been but recently killed." Captain Scoresby has not informed us why fish cannot be taken to Greenland in a frozen state, though this is a mode of preservation much used in Russia and Germany, and even in our own country.

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Some attention is necessary for thawing provisions which have been frozen. "When used, the beef cannot be divided but by an axe or a saw; the latter instrument is generally preferred. It is then put into cold water, from which it derives heat by the formation of ice around it, and soon thaws; but if put into hot water, much of the gravy is extracted, and the meat is injured without being thawed more readily. If an attempt be made to cook it before it is thawed, it may be burnt on the outside, while the centre remains raw, or actually in a frozen state." These observations, which we have transcribed from Captain Scoresby,* an excellent observer, agree with the directions of earlier writers. Thus Krünitz says, (*Encyclop.* Vol. X. p. 586), "when fish taken under the ice are frozen, lay them in cold water, which thus draws the ice out of the fish, so that it can be scraped off their scales. They taste much better afterwards than when they are allowed to thaw in a warm room." We do not know whether it be ignorance or inattention to this direction on the part of the London fishmongers which causes the salmon sent from Scotland in ice to be little esteemed.

The second general method of preventing fermentation is desiccation, or the removal of that degree of moisture which is an essential condition to this kind of chemical action. Desiccation takes place in consequence of the air absorbing the moisture of bodies exposed to its action. It is therefore promoted by the size of surface exposed, by the dry state of the atmosphere, increased temperature, and by the constant change of the air in contact with the body to be dried, or, in other words, by exposing it to a free current of air. This mode of checking fermentation is assisted by dividing or cutting the bodies to be dried, especially across the grain, which acts not only by increasing the surface, but perhaps still more by dividing the vessels containing the moisture or fluids, and thus allowing them to be freely acted upon by the air, to which the skin or epidermis, when entire, frequently exposes a very great obstacle. In pharmacy, where exsiccation is often necessary, this is well understood, and expressed in the Collegiate directions for drying squills, and other succulent roots. In domestic economy, it is also practised in drying artichoke bottoms, and guarded against when vegetables are required to be kept succulent, which are or ought to be trimmed or wounded as little as possible till they are to be used. Animal substances also dry much more slowly so long as the surface is entire; and hence some country butchers skin veal joint by joint only, as it is required. The influence of extent of surface is a matter of constant observation. A little water, which would have required days to have evaporated out of a wine glass, disappears in a few minutes when spread over a China plate. Also solid substances dry more quickly in proportion to the smallness of their size, as the surface exposed is proportionably greater. But none of the agents in accelerating exsiccation has so great an influence as the dry state of the air by which it is effected.

Mr Hearne (*Journey to the Northern Ocean*) gives an account of the manner in which the Indians of North America preserve, by means of mere exsiccation, the flesh of musk oxen, deer, or any other animal. To prepare meat in this manner, no farther operation is required, than cutting the lean parts of the animal into thin slices, and drying it in the sun, or by exposing it to the heat of a fire, when it is reduced to powder by beating it between two stones. Meat prepared in this way is very portable, and always ready for use, and it is very substantial; for Mr Hearne found, that he could always travel longer without victuals after making a meal of it, than after any other kind of food. The northern Indians dry their meat by the heat of a very slow fire, or by fastening it to the tops of the women's bundles, and allowing it to dry by the sun and wind as they walked along. But the southern Indians expose it to the heat of a very large fire, which, in Mr Hearne's opinion, exhausts its juices, renders it as hard as horn, and gives it a bitter taste, whereas the other is soft and mellow in the mouth, and entirely free from smoke. Fish is also dried by them in the sun, and pounded for the sake of carriage.

The third general means of preventing fermentation is the total exclusion of atmospheric air, or rather of oxygen. The truth of this is not so obvious to common observation as that of the others; for, on the contrary, we every day see substances spoiled by being apparently excluded from the air, but, in reality, by being shut up in confined air; and we are taught to consider free ventilation as a powerful means of preservation. The manner in which the latter acts we have shown to be by removing moisture, especially when contaminated by the exhalation of the perishable substance. The *rationale* of the former is more obscure, but has been ingeniously attempted by Gay Lussac and the *Edinburgh Review* (No. XLV.), in order to explain the processes of M. Appert. Gay Lussac found that neither fresh vegetable juices nor animal matter fermented so long as oxygen gas was perfectly excluded; and that the fermentation, in both cases, commenced as soon as any portion of oxygen was admitted. When oxygen gas is confined in contact with a fermentable substance, it is changed into an equal bulk of carbonic acid gas, and all farther action ceases. Methods of preserving fermentable substances, illustrative of this principle, have long been practised imperfectly by housewives. Nothing can be simpler than Mr Raffald's receipt for preserving green peas, cranberries, currants, &c. "Put them into dry clean bottles, cork them close, and tie them with a bladder; keep them in a cool dry place." A variation of this process was to fill the bottles previously with sulphurous acid vapour, by holding in them for some time a lighted sulphur match. One effect of this is to remove all uncombined oxygen. Other methods of excluding air were also employed, as filling up the interstices with water or melted suet. The success of this process was greatly promoted by subjecting the substances to the action of a certain degree of heat,

* See his *Account of the Arctic Regions, with a History and Description of the Northern Whale Fishery.* 2 vols. 8vo. Edinb. 1819.

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after being put into the bottles or jars in which they were to be preserved; and then we are desired "to set them in a copper of hot water till they are hot quite through," or to "put them in an oven when the bread is drawn, and let them stand till shrunk a quarter part."

In these cases, the heat seems to act by coagulating and rendering insoluble and inactive a kind of gluten which seems to be a principal agent in beginning fermentation. In general, in the old processes, we were directed not to cork or tie up the vessels until they were quite cool, by which it now appears a very great advantage was lost. But Mr Saddington obtained, in 1817, a premium from the *Society of Arts* for a method of preserving fruit without sugar, for house or sea stores; the chief peculiarity of which consisted in filling the bottles, as soon as they are taken out of the bath, with boiling water to within an inch of the cork, and immediately corking them very tight and laying them on their sides, that the cork may swell and effectually exclude the air. Animal substances have also long been occasionally preserved by the mere exclusion of air. The most familiar example is the buttering of eggs, which has the effect of closing the pores in the shell by which the communication of the embryo with the external air takes place. It is best performed by rubbing over the shell with butter while it is still warm after being laid; and an egg in this way retains the curdy milk, and possesses all the properties of a new laid egg for a great length of time; but at whatever period after being laid the egg is buttered over, its progress to decay seems to be arrested. The same effect is produced, though not so perfectly, by immersing eggs in water. From an experiment of Reaumur's, it appears that the cutting off the access of air to the embryo in the egg, does not kill it or prevent it from being hatched, but, on the contrary, preserves it alive for a much greater time than if it had not been treated in this manner. He covered over eggs with spirit varnish, and he found them capable of producing chickens after two years, when the varnish was carefully removed.

Although, however, the preservation of alimentary matters by the total exclusion of air, assisted by subjecting them to a certain degree of heat, has long been practised in some degree, we are certainly indebted to M. Appert, * who first published in 1810, for the regular and scientific application of these principles upon a large scale. From extensive experience and long perseverance he became convinced,

"1*st*, That fire has the peculiar property, not only of changing the combination of the constituent parts of vegetable and animal productions, but also of retarding, for many years at least, if not of destroying, the natural tendency of those same productions to decomposition.

"2*d*, That the application of fire in a manner variously adapted to various substances, after having, with the utmost care, and as completely as possible, deprived them of all contact with the air, effects a perfect preservation of those same productions, with all their natural qualities."

Upon these principles he invented many processes adapted to the different natures of the substances to be preserved; but the fundamental conditions consist, 1*st*, In inclosing in bottles the substances to be preserved. 2*d*, In corking the bottles with the utmost care; for it is chiefly on the corking that the success of the process depends. 3*d*, In submitting these inclosed cases to the action of boiling water in a water-bath (*Balneum Mariae*), for a greater or less length of time, according to their nature, and in the manner pointed out with respect to each several kind of substance. 4*th*, In withdrawing the bottles from the water-bath at the period described.

M. Appert employed at first bottles made of glass, which it was difficult to close exactly, especially when their mouths were large; but he now uses cylinders of tin plate, which are soldered up after they are filled. This is especially an improvement for animal substances, which require much more attention than vegetables. Tin cases, or canisters, seem to have been first used in London by Messrs Donkin and Gamble, by whom a very ingenious method of testing the provisions put up by them was also invented as early as 1813. † The substances to be preserved are first parboiled or somewhat more. The vegetables and meat, the bones being removed, are then put into tin cylinders, which are filled up with the broth and the lid soldered down. It now undergoes the remainder of the cooking, when a small hole is opened at the top of the cylinder, and immediately closed with solder while still hot. The whole is now allowed to cool, and from the diminution of volume in the contents, in consequence of the reduction of temperature, both ends of the cylinder are pressed inwards and become concave. The cases thus hermetically sealed are exposed in a *test-chamber* for at least a month, to a temperature above what they are ever likely to encounter; from 90^0 to 110^0 Fahrenheit. If the process has failed, putrefaction takes place, and gas is evolved, which in process of time will bulge out both ends of the case, so as to render them convex, instead of concave. But the contents of whatever cases stand this test, will infallibly keep perfectly sweet and good in any climate, and for any length of time. Another advantage is, that if there be any taint about the meat when put up, it inevitably ferments, and is detected in the proving.

All kinds of alimentary matters may be preserved in this way,—beef, mutton, veal, and poultry, boiled and roasted, soups, broths and vegetables, creams and custards. The testimonies in

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* *Le livre de tous les menages; ou l'art de conserver pendant plusieurs années toutes les substances animales et vegetales.* 3me edit. Paris, 1813.

† In a patent granted, in 1819, to Mr Æneas Morrison of Glasgow, for preserving food upon similar principles, the corks or bungs are perforated by a tin tube, which is hermetically sealed by driving down a tin plug while the vessel is still quite hot and filled with steam.

favour of the success of the process are of the most unexceptionable kind. The meat is put up in canisters of from 4 lbs. to 20 lbs. weight each; and the milk and soups in quart or pint bottles. The meat is charged from 1s. 8d. to 3s. a pound; roast higher than boiled, and veal dearer than mutton or beef. The milk is 24s. *per* dozen for quarts, 15s. for pints, and 10s. for half pints; and soups from 30s. to 60s. *per* dozen for quarts. The weight of the canister is deducted, and nothing is charged for canisters or bottles; and it should be observed, that the patent provisions being cooked, and without bone, render them nearly equivalent to double the weight of meat in the raw state; for, by experiment, the patentees found, that the waste in cooking and weight of bone are about one half. Captain Neish took a quantity to India, not one canister spoiled; and one which he brought home contained beef in the highest state of preservation after two years, and having been carried upwards of 35,000 miles in the warmest climates. The commissioners for victualling the navy also examined some nearly four years old, which had been in the Mediterranean and Quebec, and found it as sound, sweet, and fresh, as if it had been only yesterday boiled. We are enabled to add the testimony of that distinguished navigator Captain Basil Hall, who has liberally communicated to us the result of his personal experience and observation: "I can answer for the perfect preservation of a great number of cases which were in my possession during the voyage to China. I had L. 88 worth, and not one failure. At that time milk was preserved in bottles corked; but tin cases have been substituted with very great effect, as I have myself tried. It is really astonishing how excellent the milk is; and, indeed, every thing preserved in this way is good.

"You must, on examining the lists of prices, bear in mind, that meat thus preserved *eats* nothing, nor *drinks*—is not apt to get the rot, or to die—does not *tumble* over board, nor get its legs broken, or its flesh worn off its bones, by knocking about the decks of a ship in bad weather—it takes no care in the keeping—it is always ready—may be eat cold or hot—and thus enables you to toss into a boat in a minute, as many days' *cooked* provisions as you choose—it is not exposed to the vicissitudes of markets, nor is it scourged up to a monstrous price (as at St Helena), because there is no alternative. Besides these advantages, it enables one to indulge in a number of luxuries, which no care or expence *could* procure."

The property of salt to preserve animal substances from putrefaction, is of most essential importance to the empire in general, and to the remote grazing districts in particular. It enables the latter to dispose of their live stock, and distant navigation is wholly dependant upon it. All kinds of animal substances may be preserved by salt, but beef and pork are the only staple articles of this kind. In general, the pieces of the animal best fitted for being salted are those which contain fewest large blood-vessels, and are most solid. Some recommend all the glands to be cut out, and say, that without this precaution meat cannot be preserved; but that this is a mistake, the salt udder and glands of the tongue, every day's experience, shows.

The salting may be performed either by dry rubbing, or by immersing the meat in pickle. Cured in the former way the meat will keep longer, but it is more altered in its valuable properties; in the latter way it is more delicate and nutritious. Six pounds of salt, one pound of sugar, and four ounces of saltpetre, boiled with four gallons of water, skimmed and allowed to cool, forms a very strong pickle, which will preserve any meat completely immersed in it. To effect this, which is essential, either a heavy board, or flat stone, must be laid upon the meat. The same pickle may be used repeatedly, provided it be boiled up occasionally with additional salt to restore its strength, diminished by the combination of part of the salt with the meat, and by the dilution of the pickle by the juices of the meat extracted. By boiling, the albumen, which would cause the pickle to spoil, is coagulated, and rises in the form of scum, which must be carefully removed.

Dry salting is performed by rubbing the surface of the meat all over with salt; and it is generally believed that the process of salting is promoted if the salt be rubbed in with a heavy hand. On the contrary, it is said, that in very hot countries, *e. g.* Jamaica, where it is so necessary that the action of the salt should take place as quickly as possible, the mode of salting a round of beef, is to place it on two sticks over a tub of water, with the small end uppermost, and to cover it with a heap of salt, which penetrates through the veins and arteries, and among the fibres, in the state of a saturated solution. However this may be, it is almost certain that very little salt penetrates, except through the cut surfaces, to which it should therefore be chiefly applied; and all holes, whether natural or artificial, should be particularly attended to. For each twenty-five pounds of meat, about a pound of coarse-grained salt (St Ubes's is the best) should be allowed, and the whole, previously heated, rubbed in at once. When laid in the pickling tub, a brine is soon formed by the salt dissolved in the juice of the meat which it extracts, and with this the meat should be rubbed every day, and a different side turned down. In ten or twelve days it will be sufficiently cured.

For domestic use, the meat should not be salted as soon as it comes from the market, but kept until its fibre has become short and tender, as these changes do not take place after it has been acted upon by the salt. But in the provision trade, "the expedition with which the animals are slaughtered, the meat cut up and salted, and afterwards packed, is astonishing." (Wakefield's *Ireland*, Vol. I. p. 750.) By salting the meat while still warm, and before the fluids are coagulated, the salt penetrates immediately, by means of the vessels, through the whole substance of the meat; and hence meat is admirably cured at Tunis, even in the hottest season; so that Mr Jackson, in his *Reflections on the Trade of the Mediterranean*, recommends ships being supplied there with their provisions.

"Take half a pound of black pepper, half a pound of red or kyan pepper, and half a pound of the best saltpetre, all beat or ground very fine; mix these three well together, then mix them with about three

quarts of very fine salt: this mixture is sufficient for eight hundred weight of beef. As the pieces are brought from the person cutting up, first sprinkle the pieces with the spice, and introduce a little into all the thickest parts; if it cannot be done otherwise, make a small incision with a knife. The first salter, after rubbing salt and spice well into the meat, should take and mould the piece, the same as washing a shirt upon a board; this may be very easily done, and the meat being lately killed, is soft and pliable; this moulding opens the grain of the meat, which will make it imbibe the spice and salt much quicker than the common method of salting. The first salter hands his piece over to the second salter, who moulds and rubs the salt well into the meat, and if he observes occasion, introduces the spice; when the second salter has finished his piece, he folds it up as close as possible, and hands it to the packer at the harness tubs, who must be stationed near him: the packer must be careful to pack his harness tubs as close as possible.

"All the work must be carried on in the shade, but where there is a strong current of air, the harness tubs in particular; this being a very material point in curing the meat in a hot climate. Meat may be cured in this manner with the greatest safety, when the thermometer, in the shade, is at 110°, the extreme heat assisting the curing.

"A good sized bullock, of six or seven hundred weight, may be killed and salted within the hour.

"The person who attends with the spice near the first salter has the greatest trust imposed upon him; besides the spice, he should be well satisfied that the piece is sufficiently salted, before he permits the first salter to hand the piece over to the second salter.

"All the salt should be very fine, and the packer, besides sprinkling the bottom of his harness tubs, should be careful to put plenty of salt between each tier of meat, which is very soon turned into the finest pickle. The pickle will nearly cover the meat as fast as the packer can stow it away. It is always a good sign that the meat is very safe, when the packer begins to complain that his hands are aching with cold.

"By this method, there is no doubt but that the meat is perfectly cured in three hours, from the time of killing the bullock: the saltpetre in a very little time strikes through the meat; however, it is always better to let it lie in the harness tubs till the following morning, when it will have an exceeding pleasant smell on opening the harness tubs; then take it out and pack it in tight barrels, with its own pickle."

Beef and pork, in a less degree, properly salted with salt alone, acquire a green colour; but if an ounce of saltpetre be added to each five pounds of salt employed, the muscular fibre acquires a fine red colour; but this improvement in appearance is more than compensated by its becoming harder and harsher to the taste; to correct which, a proportion of sugar or molasses is often added. But the red colour may be given if desired, without hardening the meat, by the addition of a little cochineal.

Meat, when salted, is either preserved immersed in pickle, in close vessels, or dried, when it gets the name of bacon, ham, or hung beef.

Meat kept immersed in pickle rather gains weight. In one experiment by Messrs Donkin and Gamble, there was a gain of three *per cent.*, and in another of two and a half; but in the common way of salting, when the meat is not immersed in pickle, there is a loss of about one pound or one and a half in sixteen.

The drying of salt meat is effected either by hanging it in a dry and well-aired place, or by exposing it at the same time to wood smoke, which gives it a peculiar flavour, much admired in Westphalia hams and Hamburg beef, and also, perhaps, tends to preserve it, by the antiseptic action of the pyrolignic acid. When meat is to be hung, it need not be so highly salted.

Fish, in like manner, may be preserved either by dry salting or in pickle. The former method is employed to a great extent on the banks of Newfoundland, and in Shetland. For information on this important subject, the article FISHERY may be consulted.

Dr Hibbert thinks that the cod-fish prepared in Shetland will always maintain its pre-eminence over the cod of other places. In Newfoundland the fish are said to be exposed, after being salted, on standing flakes, made by a slight wattle, and supported by poles, often twenty feet from the ground. But the humidity is not nearly so well extracted from the fish, as when, according to the Shetland method, they are carefully laid out upon dry beaches, the stones of which have been during winter exposed to the abrading action of the ocean, and are thus cleared from animal and vegetable matter. (*Edinburgh Philosophical Journal*, No. III. p. 148.)

The Dutch derive great national advantages from the preference given to the herrings caught upon our own coasts, when cured by them. They use no other than the Spanish or Portuguese salt, preserve no fish that they are not able to cure between sunrise, when the nets are drawn, and sunset, when they are again shot, and pay particular attention in giping, sorting, and packing each kind by itself. They fill up the barrels with fish of the same kind and night's catching, and are exceedingly careful of the pickle, as they use no other in filling of the barrels. (*Highland Society's Transactions*, Vol. II. p. 321.)

Herrings and salmon are also often cured by drying them in wood smoke after being slightly salted, and are called red herrings, or Yarmouth herrings, and kipper, or smoked salmon.

Butter is commonly preserved by working into each pound one or two ounces of salt, until they be thoroughly incorporated. The best salt for the purpose is in large crystals, and it should be thoroughly dried and coarsely powdered. But Dr Anderson recommends for the curing of butter, a mixture of two parts of the best great salt, one of sugar, and one of saltpetre, beat into a fine powder. One ounce of this mixture is sufficient for a pound of butter. He says that butter cured in this way does not taste well till it has stood at least a fortnight after being salted, but after that period it has a rich

marrowy taste, that no other butter ever acquires, and tastes so little salt, that one would imagine it would not keep; and yet Dr Anderson has seen it perfectly sound and sweet when two years old.

Butter spoils and becomes rancid, chiefly from the milk, which is not entirely expressed from it, and in consequence of the albumen, which is constantly present. These may be separated by melting the butter and keeping it over the fire until all the water be evaporated, when the albumen will also be coagulated, and sink to the bottom. To prevent all risk of producing an empyreumatic taste, the vessel containing the butter should not be exposed directly to the fire, but placed in a larger vessel filled with water, which is made to boil, forming what the chemists call a water-bath. While the butter remains fluid, it resembles a perfectly transparent oil, and on cooling it becomes opaque, and is firmer and a little paler than the butter before it was clarified. It will keep for a considerable time without salt; but if it be salted as common butter, it will continue much longer sweet in hot climates, than if it had been cured in its original state. (Anderson's *Recreations*, Vol. IV. p. 87.)

The natives of Hindostan never use butter, but prefer what is called *ghee*, because it keeps better, and has more taste and smell. Their butter is prepared from coagulated acid milk; and in order to collect a sufficient quantity, it is often kept two or three days, by which time it is highly rancid. It is melted in an earthen pot, and boiled until all the water be evaporated. After being taken from the fire, a little coagulated acid milk and salt, or betel leaf and reddle, are added. It is kept in pots, and eaten when even a year old. (Buchanan's *Journey from Madras*, Vol. II. p. 15.)

Vinegar, in itself a very destructible substance when exposed to the air, tends greatly to preserve vegetable substances, when both are carefully excluded from it. In general, however, the vegetable is previously salted. After the pickles are prepared, the bottles are to be carefully corked, tied up with bladder, and sealed over with wax or rosin. For the making of pickles, the vinegar now distilled from wood, as in itself containing no principles of decay, must be preferable to common vinegar.

M. Parmentier has given a minute description of the process of making sour krout on the great scale. The heads of winter cabbages, after removing the outer leaves, are to be cut into fine shreds, by means of an instrument made on purpose, and then spread out to dry upon a cloth in the shade. A cask is to be set on end, with the head taken out. If it formerly contained vinegar or wine, so much the better, as it will promote the fermentation, and give the cabbage a more vinous taste; if not, the inside may be rubbed over with some krout barm. Caraway seeds are to be mixed with the shreds of cabbage, a good layer of salt placed at the bottom of the cask, and then cabbage shreds to be evenly packed, to the depth of six inches. A man having on strong boots, well washed and nicely clean, must now get into the cask, and tread down the shreds to half their original bulk. The same process is to be repeated, with additional layers of salt, and shreds, till the whole be packed. They are then to be covered with a layer of salt, or till the barrel be filled within two inches of the top, over which the outside leaves of the cabbages are to be spread. About two pounds of salt are required for twenty cabbages.

The head of the barrel, which should have been previously well fastened together, is lastly to be put within the barrel above the leaves, and loaded with stones, to prevent the mixture from rising during the fermentation. The mass thus compressed subsides, and the cabbages give out their juice, which rises to the surface, is green, muddy, and fetid. It is to be drawn off by a spigot placed two or three inches down, and replaced by fresh brine every day, until it come off clear, which will take twelve or fifteen days, according to the temperature of the place. The essential point for keeping sour krout good, is to take care that it be always covered at least an inch with pickle. For home consumption enough may be made at one time to serve the year, and the pickle is then renewed at the beginning of spring, and at midsummer. When intended as ship provision for long voyages, the sour krout must be repacked very firmly into other casks, which are then to be filled with fresh pickle, and closed as accurately as possible. When well made and preserved, it has a very pleasant acidity, and is not only very healthy, but agrees with many persons who cannot use fresh cabbages. It is also considered to be a very excellent antiscorbutic; and Captain Cook attributed his success in preserving the health of his crew in his voyage, partly to its use.

Vinegar is never used for the preservation of butcher meat, but salmon is often pickled in it, with the addition of salt and spices.

Pyrolignic acid has lately been much extolled, as having a specific power in preserving animal matters. It consists of acetic acid, impregnated with an empyreumatic oil. The acid is in general very strong, and being free from the mucilage which promotes the spoiling of common vinegar, it is so far a better antiseptic; but the empyreumatic oil may also add to its powers, either by keeping away insects, to which it is very offensive, or by a direct antiseptic power not understood. Professor Jörg of Leipsic is said to have recovered tainted flesh by rubbing it with the oil separated from the acid; and there is no doubt that the smoking of beef, hams, salmon, and herrings, makes them keep longer than the mere drying, and the degree of previous salting, would lead us to expect.

Sugar has also the power of preserving vegetable substances from decay, but, on account of its expence, it is only used for fine fruits and aromatic substances. The preservation of these by means of sugar constitutes a principal part of the art of confectionary, and attention to many minutiæ is necessary for the success of each preparation. The most general principles only can be noticed here.

Vegetable substances may be either preserved in syrup or candied; or their juices may be employed in making syrups, jellies, or fruit-cakes. The art of confectionary is very difficult, and to attain perfect success, requires attention to many particulars, which at first seem frivolous and even improper,

but which have been found by experience to be essential. The clarification and boiling of the sugar to its proper degree is of primary importance, and has not perhaps been sufficiently examined by scientific men.

A weak syrup has a tendency to ferment, and quickly becomes sour if kept in a temperate degree of heat; it is therefore not calculated to prevent the natural fermentation of vegetable juices, which always increase its tendency to corrupt. Pharmaceutists have ascertained that a solution, prepared by dissolving two parts of double refined sugar into one of water, or any watery fluid, and boiling the solution a little, forms a syrup, which neither ferments nor crystallizes; and the proportion may be considered as the basis of all syrups, and seems to be the degree of boiling syrup called smooth by the confectioners, as exemplified in their *Syrops de Capillaire, Orgeat*, &c.

Sugar is equally powerful in preserving animal substances from putrefaction. As a novelty to modern artists, we translate from their great precursor, Cælius Apicius, a method of preserving meat at any time without salt: "Let fresh meat of any kind be covered with honey; but hang up the vessel, and use it when you please. This succeeds better in winter; but will last a few days in summer. The same may be done with meat that has been cooked." (Lib. I. cap. 8.)

Other methods of preserving food have been tried, but rather as a matter of curiosity than utility.

The property of charcoal, to restore sweetness to flesh beginning to be tainted, was first pointed out by M. Lowitz in Petersburg, in 1786 (Crell's *Annals*), who made numerous experiments upon the subject. For their success, it is necessary that the charcoal have been recently burnt, and that it be applied in a certain quantity. Too little fails in its effect, and too much affects the nature of the substance upon which it acts. By some it has been supposed to act merely mechanically, by absorbing fluid and putrescent exudations; but it is more probable, that it acts chemically, by absorbing oxygen gas from the air in contact with the meat. In the 4th volume of the *Journal of Science*, p. 367, there is an account of some successful experiments, in which alternate layers of meat and charcoal were packed in canisters, previously filled with carbonic gas, and then carefully luted up, and covered with bladder.

In the *Journal de Pharmacie* for September 1818, M. Raymond, Professor of Chemistry at Lyons, has related some experiments which he made upon the antiseptic properties of chlorine. Beef, exposed to the action of this gas for a few minutes, underwent no change in the course of six months, except becoming dry from the action of air and time. A Guinea-pig, suffocated in the same gas, and afterwards immersed for a few minutes in water saturated with chlorine, and then exposed to the air for four months, without having its entrails removed, showed no sign of putrefaction in four months. He also found that tainted meat recovered the smell and appearance of fresh meat by being immersed in liquid chlorine.

Preparation.

Alimentary matters are used either in their crude or raw state, or after having undergone some kind of preparation.

Fruits and salads, although they admit of various forms of cookery, are most frequently eaten in as fresh and natural a state as possible.

Cookery is either necessary to destroy some deleterious property, or to render food more palatable and nutritious. Of the former effect the most remarkable example is furnished by various species of *arum*, which, in their crude state, are acrid, or even poisonous, but, by being cooked, become mild and wholesome. The acrimony resides in a very volatile principle, which is easily dissipated by heat. A more familiar example in this country is furnished by the onion tribe, the acrimony and flavour of which are entirely destroyed by being long subjected to the action of heat.

Numerous as the receipts are, the processes of cookery are but few. In some, the chief object is to extract the fluid or soluble parts of the substance cooked; in others, to alter the nature of the substance itself, and often to combine both purposes. Fire is a principal agent in almost all the processes of cookery, and the most economical mode of applying it has engaged the attention of many philosophers and artists. *

Convenience and economy are the objects proposed by all alleged improvements. The nature of the fuel is of no little importance, and is different in different countries. Pit-coal has the advantage of forming a lasting fire, and producing an intense degree of heat, which renders it almost indispensable for roasting; but its smoke is very detrimental, both by the unpleasant flavour it imparts, and by the inconvenience arising from the flame, and from the soot deposited upon the vessels and in the chimney. Wood and turf evolve less smoke, but their flavour is more penetrating, and they give less heat, and are less durable. The cleanest and most generally useful fuel is charcoal of wood, or coke; neither giving out any smoke, or imparting any flavour. Charcoal is more easily kindled, but coke lasts longer, and gives out more heat. Well burnt cinders are an excellent substitute for coke, which in every family ought to be carefully preserved for the purposes of cookery.

The heat, from whatever fuel produced, is applied in various ways to the substances to be cooked, either directly or indirectly. Heat is applied directly, as radiant heat in the process of roasting, in which the effects are produced entirely by the rays of heat impinging directly upon substances placed at a short distance before it. For this purpose a clear glowing fire is necessary, and the

* See Rumford's *Essays;* Fournier, *sur les Substances Alimentaires; Repertory of Arts; Archives des Decouvertes.*

Preparation of Food.

bars of a good roasting grate should impede as little as possible the radiation of its heat. Another very direct mode of applying heat is by placing the substance over the fire by suspending it in the stream of heated air ascending from it, or laying it directly on the burning fuel, or on bars, or a plate of iron, or other substance capable of supporting the heat. Broiling is the result of this mode of applying heat. Heat is also often applied through the intervention of fluids, chiefly of water or steam, as in boiling or stewing; or of some oily substance, as in frying. The peculiarity of baking consists in the substance being heated in a confined space, which does not permit the escape of the fumes arising from it.

To understand the theory of cookery, we must attend to the action of heat upon the various constituents of alimentary substances, as applied directly and indirectly through the medium of some fluid. In the former way, as exemplified in the processes of roasting and broiling, the chief constituents of animal substances undergo the following changes—the fibrine is corrugated, the albumen coagulated, the gelatine and osmazome rendered more soluble in water, the fat liquified, and the water evaporated. If the heat exceed a certain degree, the surface becomes first brown, and then scorched. In consequence of these changes, the muscular fibre becomes opaque, shorter, firmer, and drier; the tendons less opaque, softer, and gluey; the fat is either melted out, or rendered semitransparent. Animal fluids become more transparent; the albumen is coagulated and separated, and they dissolve gelatine and osmazome. Lastly, and what is the most important change, and the immediate object of all cookery, the meat loses the vapid nauseous smell and taste peculiar to its raw state, and it becomes savoury and grateful. Heat applied through the intervention of boiling oil or melted fat, as in frying, produces nearly the same changes, as the heat is sufficient to evaporate the water, and to induce a degree of scorching. But when water is the medium through which heat is applied, as in boiling, stewing, and baking, the effects are somewhat different, as the heat never exceeds 212°, which is not sufficient to commence the process of browning or decomposition, and the soluble constituents are removed by being dissolved in the water, forming soup or broth; or, if the direct contact of the water be prevented, they are dissolved in the juices of the meat, and separate in the form of gravy.

It is evident, that whether the heat be applied directly or indirectly, there must be a considerable loss in the cooking of animal substances in public institutions, where the allowance of meat is generally weighed out in its raw state, and includes bones, and is served out cooked, and sometimes without bone, and it is a matter of importance to ascertain nearly their relative proportions. Much, no doubt, depends upon the piece of the meat cooked, and the degree of cookery, and the attention bestowed on it. We have been informed by persons who salt rounds of beef to sell by retail, after they are boiled, that they are able to get 19 lb. of cold boiled beef from 25 lb. raw; but the meat, it must be confessed, is always rather underdone. Messrs Donkin and Gamble boiled in steam 56 lb. of Captain's salt beef; the meat, when cold, without the bones, which amounted to 5 lb. 6 oz. weighed only 35 lb. In another experiment, 113 lb. of prime mess beef gave 9 lb. 10 oz. of bones, and 47 lb. 8 oz. meat; and in a third, 213 lb. mess beef gave 13 lb. 8 oz. bones, and 103 lb. 10 oz. meat; or, taken in the aggregate, 372 lb. of salt beef, including bones, furnish, when boiled, 186 lb. 2 oz. without bone, being about 50 *per cent.*; or, disregarding the bone altogether, salt meat loses, by boiling, about 44.2 *per* cwt. We are indebted to Professor Wallace (of the University of Edinburgh) for the detail of a very accurate and extensive experiment in a public establishment, of which the results were, That, in pieces of 10 lbs. weight, each 100 lbs. of beef lost, on an average, by boiling, 26.4; baking, 30.2; and roasting, 32.2: mutton, the leg, by boiling, 21.4; by roasting, the shoulder, 31.1; the neck, 32.4; the loin, 35.9. Hence, generally speaking, mutton loses, by boiling, about one-fifth of its original weight, and beef about one-fourth; again, mutton and beef lose, by roasting, about one-third of their original weight.

The loss arises in roasting from the melting out of the fat and evaporating the water, but the nutritious matters remain condensed in the cooked solid; but in boiling, the loss arises partly from fat melted out, but chiefly from gelatine and osmazome dissolved in the water in which the meat is boiled; there is therefore a real loss of nourishment unless the broth be used, when this mode of cooking becomes the most economical.

Vegetable substances are most commonly boiled or baked; or if apparently fried or roasted, there is always much water present, which prevents the greater action of the fire from penetrating below the surface. The universal effect of cookery upon vegetable substances, is to dissolve in the water some of their constituents, such as the mucilage and starch, and to render those that are not properly soluble, as the gluten and fibre, softer and more pulpy.

We cannot pretend to enter into the details of the various processes, nor explain the many precautions requisite to ensure success. For practical receipts we recommend *L'Art de Cuisinier*, par A. Beauvilliers; *A New System of Domestic Cookery*, by a Lady; and, lastly and chiefly, *Apicius Redivivus, or the Cook's Oracle*, in which, along with the plainest directions, there is more of the philosophy, and, if we may so speak, of the literature of *gastronomie*, than in any work we have seen. The reader is also referred to a very curious volume by Mr Accum on *Adulterations of Food*, and to a German work on the same interesting subject by Knoblauch. The unprecedented success of the *Almanach des Gourmands*, and of the *Manuel des Amphytrions*, shows how much may be made of the subject by a man of talents; nor do the writings of M. Grimod de la Reyniere surpass in wit the entertaining articles in the rival Reviews (*Edinburgh*, No. XII. *Quarterly*, No. XLV.), or the extracts we have seen from the *Tabella Cibaria*, just published. (x.)

Forfarshire.

Situation and Extent.

FORFAR, a county in Scotland, bounded by the shires of Aberdeen and Kincardine on the north, the German Ocean on the east, the Frith of Tay, which separates it from Fife, on the south, and the county of Perth on the west. It is situated between 56° 27′ and 57° north latitude, and between 2° 28′ and 3° 22′ west longitude from Greenwich; and extends from north to south from twenty-six to thirty-four miles, and twenty-three to thirty from west to east. It contains, by the lowest computation, 832 square miles, or 532,480 English acres, without including portions of the parishes of Lundie, Cupar, and Alyth, the greater part of which belong to the county of Perth.

Surface and Natural Divisions.

More than a third of its area is occupied by the Grampians, here called the Binchinnin hills, on which it meets the Braes of Marr in Aberdeenshire. The surface of this northern division of the county, or the Braes of Angus, with the exception of the mountains at the head of Glen Clova, is not in general so bold and abrupt as many other Alpine districts of Scotland; the hills are for the most part rounded, and rather tame, and covered with a thin coat of moorish soil, carrying stunted heath. Catlaw, the highest, is 2264 feet above the level of the sea. There are several considerable vallies in this district, the principal of which are Glen Isla, Glen Prosen, Clova, Lethnot, and Glen Esk, which are watered by streams that rise in the west and north, and commonly flow south-east, receiving innumerable torrents from the mountains in their progress. South from the Grampians, and parallel to them, is another but lower range, called the Sidlaw hills, supposed to be a continuation of the Ochills; some of these hills are 1400 feet high. Between these two grand divisions lies Strathmore, the Great Valley, as the name denotes in Gaelic, or, as it is commonly called, the *How* of Angus; extending about thirty-three miles in length, and from four to six in breadth,—a district beautifully diversified by gentle eminences, fertile fields, plantations, villages, and gentlemen's seats,—very little of it 200 feet above sea level. It has been proposed to carry a canal through this valley, which might be extended to Dunbarton, and thus connect the three great rivers of Scotland, the Clyde, the Forth, and the Tay; a canal from Arbroath to Forfar has been under consideration very recently. The fourth, and remaining division, extends from the Sidlaw hills to the German Ocean on the east, and the Frith of Tay on the south, and is, with a few exceptions, a rich and well cultivated tract, varying in breadth from three to eight miles, and comprising about a fourth of the whole county.

Woods, &c.

The woods and plantations have been computed to extend to 35,000 acres, of which about 5000 may be coppice and natural wood. Several of the Grampian glens are sprinkled with birches, oak, and hazels. The botany and zoology of the county have been explored with great industry by the late Mr George Don of Forfar, who has presented a very ample enumeration in both departments, in a paper subjoined to Mr Headrick's late *Survey for the Board of Agriculture*.

Soils.

The general colour of the soils is red, but often inclining to dark brown or black. In the Grampians the soil is often moorish, over whitish retentive clay, but loose and friable in the glens. Over the puddingstone or gravelstone rock in the lower grounds, it is sometimes thin, mossy, and encumbered with stones; and over the sandstone, a tenacious clay occurs. The soil above whinstone is fertile, though sometimes shallow. In Strathmore it is often gravelly, in other parts a dead sand. There is no great extent of moss; what there is, is of much value for fuel.

Mineralogy.

The mineralogy of a considerable portion of Forfarshire was examined by Colonel Imrie, who has given a minute description of it in a paper published in the sixth volume of the *Transactions of the Royal Society of Edinburgh*. In the Grampian district, towards the summit of the county, on the confines of Aberdeenshire, the prevailing rock is granite, some of it very beautiful, with topazes or rock crystals in its cavities or fissures, known by the name of *Cairngorums*, from a mountain of that name in Aberdeenshire; also micaceous schistus, and porphyry; dikes of the latter, in some places, intersecting the former. Laminated talc or mica, called by the shepherds *sheep's siller*, from its silvery lustre, which is sometimes thickly studded with small garnets, is found in irregular veins, and siliceous spar in jutting or detached hills. Lead was wrought at Gilfianan, above the old castle of Innermark, in the upper part of the parish of Lochlee, and also at Ardoch, near Mill-den, on the Esk. At the former place, according to Edward, in his *Description of Angus*, published in 1678, it yielded one-sixty-fourth part of silver; but both mines have been long since abandoned. Limestone in small quantities frequently occurs, and is wrought in several parts; there are also broad veins of slate, but which, it is said, does not come off in plates of sufficient size for use. In descending the Grampians to Strathmore, gravelstone prevails, and afterwards, on the lower grounds, sandstone. Clay marl is found both in Strathmore and the Sidlaw hills, but is little used. Shell marl is in more request, and abounds in different parts, particularly in the lochs of Kinordie near the bottom of the Grampians, Lundie in the Sidlaw hills, Logie in the parish of Kirriemuir, and Restennet near Forfar. These lochs have been drained and rendered of easy access. It is also found in the lochs of Forfar, Rescobie, and Balgavies, where it is raised by scoops, and conveyed to the shore in boats. The Sidlaw hills are chiefly composed of sandstone of various colours, some of it susceptible of a high polish. Sandstone flags, which are much used instead of slate for covering roofs, are raised in great quantities on the hill of Balnashader, and in the moor to the south of Forfar; but the most extensive range of these flags is in the parish of Carmylie, and along the southern declivity of the Sidlaw hills. The principal lime-works are in the maritime division, at Hedderwick near Montrose, and in the parish of Craig on the sea-shore. The only mineral springs are chalybeate, one of which is near Montrose, another to the west of Arbroath, two in the side of a rivulet about a mile farther west, and one in the north-west corner of Dumbarrow in Dunichen parish.

Climate.

The heaviest rains are from the east and south-

Forfarshire. east, and the heaviest snows from the north and north-east. At Crescent, half a mile westward of Dundee, the quantity of rain that fell during six years, from 1790 to 1795 inclusive, varied from 22.27 inches to 34.12; but at Belmont, in the centre of Strathmore, during the same years, it was from 31.45 to 39.55. The mean height of the barometer at Belmont, during the first three of these years, was 29.60, and of the thermometer 42^0. At Crescent, the mean degree of cold during winter, for the whole period, was from $32\frac{1}{3}^0$ to $39\frac{3}{5}^0$, and of heat during summer, $60\frac{1}{5}^0$ to 66^0. The south-east wind blows at Crescent twenty-one, and the south-west one hundred and nine days annually, whereas at Belmont, the former prevails eighty-five and the latter one hundred and thirty-eight days.

Waters. The principal lochs or lakes have been already mentioned as containing shell-marl. To these may be added Lochlee among the Grampians, from which the North Esk issues, and Lentrathan near their base. None of the streams are so considerable as to have the name of rivers, but are called waters. The *North Esk,* after leaving Lochlee, flows towards the east, and then the south-east, where it forms the boundary between this county and Kincardineshire, and falls into the sea about three miles north-east of Montrose, having received the Mark, the Tarf, the Westwater, and the Cruick in its course. The *South Esk* rises in the north-western part of the county, among the Grampian summits of Clova, and passing by Brechin, discharges itself into the basin of Montrose, five miles from the mouth of the North Esk, after being joined by the waters of Prosen, Carrity, and other mountain streams. Its general course is from north-west to south-east. *Isla*, the last stream of any note, has also its source in the Grampians, flowing from the summit of the glen which bears its name, in a direction from north to south, until, at Ruthven, it bends to the westward, and joins the Tay in Perthshire. Below the bridge of Craig it has cut a chasm, in some places more than a hundred feet in depth, through a barrier of porphyry and gravelstone rocks, where it forms cascades of singular beauty. The Dean, the Lunan, the Dighty, and a few others, are inconsiderable streams.

Landed Property. Much of the landed property of Forfarshire has changed its owners within the last century; of the forty barons mentioned by Edward, in the work already referred to, the descendants of not more than a third of them now possess estates in it. It is, in general, divided into estates of a moderate size: in 1811, a large proportion were from L. 100 to L. 1000 a year, some from L. 2000 to L. 6000, but only one or perhaps two worth L. 12,000 a year. About a third part of the county is now held under entail. The valued rent is L. 171,239, 16s. 8d. Scots, which is divided among two hundred and sixty-six estates, three-fourths of them below L.500 Scots. The real rent of the lands in 1811 was L. 260,196, 15s. 0d. which is less than 10s. an acre, and of the houses L. 64,108 Sterling. In the same year, the number of freeholders entitled to vote for a member for the county was one hundred and seventeen. There are more than sixty gentlemen's seats, some of them venerable for their extent and antiquity, such as the Castles of Glammis, Brechin, and Airly, and the House of Panmure, and others, distinguished for elegance and the beauty of their situation. Among the latter Kinnaird Castle, the seat of Sir David Carnegie, is the most magnificent.

Farms. Farms are of every size, but in general not large, the average size of such as are arable being from 100 to 250 acres. There is a greater number below than above 100 acres. According to the *Agricultural Survey,* the whole number of farms in 1808 was 3222, of which about the half were under L. 20 of yearly rent, and only 86 above L. 300. In the western division of the Grampian district, the arable land is still held in runrig or intermixed, and the mountains in common, either without leases, or on leases not exceeding nine years. Throughout the rest of the county, the leases are commonly for nineteen or twenty-one years. The farm-houses lately erected in the lower parts of the county are in general convenient and comfortable, but in the Grampians they are still miserable huts, with walls of stone and turf alternately, five feet high, and covered with thatch fastened with ropes in the form of a hay rick. In some parts where stones are scarce, cottages and even small farm-houses are built with clay, wrought up and mixed with straw, but in general the cottages are built with stone and clay, with clay floors, and thatched roofs, one of which may be constructed for about L. 15. Their number has been much diminished of late.

Agriculture. The agriculture of Forfarshire is for the most part respectable, though modern improvements are not so general as in the Lothians and border counties of Scotland. Wheat which, according to Pennant, was a rare crop in 1775, is now cultivated to a great extent upon almost every variety of soil, to the height of 800 feet above the level of the sea; also barley, and all the other farm crops common in Scotland. In reaping the corn crops, there is a practice peculiar to this and one or two of the contiguous counties called *threaving;* the reaper is paid for his work not by the acre or by day-wages, but according to the number of sheaves he cuts down, or by the *threave,* which contains twenty-four or twenty-eight sheaves, the girth of which is specified. The advantages of this practice are, that women and children, who cannot perform full labour, find employment, working in families, on different parts of a field; while the farmer gets his crops cut low and clean, from its being their interest to fill the sheaf with the thickest part of the straw, which is always that nearest the ground. The unmarried men-servants, instead of boarding in the farmer's own house, often live apart in a place called the *bothy,* where they cook their own victuals.

Live Stock. No great progress has been made here in the improvement of live-stock. The *garron,* a small breed of horses, keeps its ground in the Grampians, where the number employed is much too considerable for the work they have to perform. The Lanarkshire, or west country breed, is common in the lower districts. There is supposed to be more than 9000 horses of all kinds and ages in the county, which

Forfarshire. were valued, in 1811, at L.220,270. The cattle in the cultivated parts, when fat, weigh from 40 to 60 stones; and, in some instances, a great deal more; and many more are fatted than reared, the practice on the grazing lands being to purchase them from the counties of Kincardine, Aberdeen, and Moray, and, after making them fat, or nearly so, to sell them for the markets in the south. They are, accordingly, of a variety of breeds. Many of the permanent or stationary stock are without horns, and seem to be allied to the Galloways. Oxen were formerly employed in labour, but are now rarely used but in turning up soils overrun with broom and other shrubs. The permanent stock of cattle is said to be about 37,400, worth L.261,800. There are few flocks of sheep, except in the Grampians, and the highest of the Sidlaw-hills, though almost every residing proprietor, and many of the farmers, keep a small number. The original breed is the small white or yellow-faced; but the Linton, or black-faced, is the most numerous. The number is computed to be 60,000, and the value L.42,000. A herd of fallow-deer is kept in the parish of Panmure.

Royal Burghs. Forfarshire contains five royal burghs, with a number of villages and hamlets; and a pretty large proportion of its inhabitants are employed in manufactures and commerce. The royal burghs are, 1. *Forfar*, the county town, with a population, in 1811, of 5652. 2. *Dundee*, a place of considerable trade, where coarse linens or Osnaburghs, sail-cloth, and cordage, are manufactured to a great amount; population in 1811, 29,716. This town has constructed two light-houses on the sands of Barry, contiguous to the Frith of Tay, the one about 60 feet high, built of stone, and the other 40 feet high, of wood. The light on the latter is shifted, so as to correspond with the changes that often occur in the sands; and the seamen, in entering the frith, make it a rule to keep both lights in a line, or both in one, as they express it. 3. *Aberbrothick*, or Arbroath, with a population of 9233. The Bell Rock, on which a light-house has been lately erected, is about 12 miles south-east from the harbour. 4. *Montrose*, population 8955. This is also a place of considerable trade, with much the same manufactures as Dundee. The self-electing system of the Scottish burghs was abolished here very recently, and the magistrates are now chosen by the burgesses. And, 5. *Brechin*, containing 5559 inhabitants. This town was noted within these few years for its brewery of porter and ale, much of the former being sent even to London. To these may be added, Kirriemuir, a village containing a population of 4791, Cupar Angus, of which, however, only a small part is in this county, most of it being in Perthshire, Glammis, Douglastown, and Letham. In 1808, 11,269,867½ yards of linen were stamped for sale in the county, the value of which was near half a million Sterling. About half as much more might be made for domestic use and private sale which was not stamped.

Shipping. There are two customhouses in Forfarshire, one at Dundee, and another at Montrose. In 1812, there belonged to Dundee 147 vessels, carrying 13,080 tons, and navigated by 1077 seamen; and to Montrose, including Arbroath, Johnshaven, and Gourdon, 9120 tons of shipping, and 597 seamen. Seven of the vessels, of more than 300 tons each, were then employed in the whale-fishery, the others in the foreign and coasting trade.

Fisheries. The fisheries on the coast of this county have not been prosecuted with great success. The boats employed are generally small, requiring only four hands. Of late considerable quantities of herrings have been caught in the months of June, July, and August. But the river fisheries have become of great value since the plan was adopted, at the suggestion of the late Mr Dempster of Dunichen, of conveying fresh salmon to London packed in ice. Mr Headrick estimates the produce of six of these fisheries, in 1810, at L.7450. The greatest salmon fisheries are in the Frith of Tay, and were carried on chiefly by stake-nets, a practice which was objected to by the proprietors higher up the river, and which, it is believed, has been since declared illegal.

Antiquities. Many religious and military ruins are to be found in Forfarshire. Near the cathedral of Brechin is a curious round tower, of which, though they be common in Ireland, only two, it is said, have been observed in Britain, this, and another similar to it at Abernethy, in Perthshire. See BRECHIN, in the *Encyclopædia*. At Arbroath are the remains of an abbey, founded by William the Lion, in 1178, and very richly endowed, where that parliament of Robert Bruce was held which addressed the celebrated remonstrance to the Pope, asserting the independence of the kingdom. A hill fort called *Cater-thun*, in the parish of Menmuir, north-west of Brechin, is worthy of notice. Pennant thinks it was one of the posts occupied by the Caledonians before their engagement with Agricola, at the foot of the Grampians.

Representation. The county of Forfar sends one member to Parliament; and the burghs of Forfar and Dundee, joined with Perth, Cupar Fife, and St Andrews, and Arbroath, Montrose, and Brechin, with Inverbervie and Aberdeen, choose two members for the Scottish burghs. It contains fifty-three entire parishes, besides portions of three others, which belong to presbyteries that meet at Forfar, Dundee, Brechin, Meigle, and Arbroath, and which, with the presbytery of Fordun, compose the synod of Angus and Mearns. There is no assessment for the poor in the county. Its population, in 1800 and 1811, will be seen from the following abstract. Population.

See Edward's *Description of Angus*, reprinted in 1791, and Colonel Imrie's *Section of the Grampians*, already referred to—*Beauties of Scotland*, Vol. IV.—Headrick's *General View of the Agriculture of Angus or Forfarshire*—*Memoirs of the Wernerian Society*, Vol. II.—*The General Report of Scotland*,—and Playfair's *Description of Scotland*, Vol. I.

1800.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
20,195	24,087	827	45,461	53,666	8627	14,827	47,450	99,127

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
16,135	24,750	505	48,151	59,113	4980	13,616	6154	107,264

(A.)

FORSTER (John Reinhold), a celebrated naturalist and geographer, and an accomplished scholar and linguist, was born 22d October 1729, at Dirschaw in Polish Prussia, where his father was burgomaster or mayor. His family was of English descent, and had quitted Great Britain in the times of Charles I.

At the age of fourteen he was placed for a year at the public school of Marienwerder, and was afterwards admitted into the gymnasium of Joachimsthal at Berlin; among his schoolfellows was Pallas, who became so well known for his various researches in natural history, with several others who distinguished themselves in literature and science. He applied himself with diligence to the study of the ancient and modern languages, and in particular of the oriental languages, as connected with divinity. He continued the same pursuits at the university of Halle, where he went in 1748. After three years, having completed his theological studies, he resided for two years more at Dantzic, preaching as a candidate. In 1753 he obtained a small benefice at the neighbouring town of Nassenhuben; the next year he married his cousin Elizabeth Nikolai; but he still found leisure to improve himself in natural philosophy, geography, and the mathematics. His increasing family having become too expensive for his income, he accepted the proposals of the Russian consul at Dantzic, and agreed to superintend the establishment of the new colonies at Saratof on the Volga. The consul received the thanks of the reigning favourite, Count Orlof, for his judicious selection of a person so well qualified; but our adventurer was not satisfied with his success in the undertaking, and, in 1766, he resolved, somewhat suddenly, to try his fortune in England, where he went well recommended, but with exhausted finances. Soon afterwards, however, he received a gratuity of 100 guineas from the Russian government, and he obtained some remuneration from the booksellers for his translations from the German and the Swedish. He declined a proposal of Lord Baltimore, who offered him the management of his large estates in America, preferring the appointment of a teacher of modern languages and natural history in the dissenting Academy of Warrington, where he found a more interesting society than would have been attainable in any part of the New World. He was not, however, very popular as an instructor; and he was soon after this engaged to accompany Mr Dalrymple, who was going out as Governor of Balambanjan, near Borneo; but the plan was never executed. In 1772 he was appointed naturalist to the expedition under the command of Captain Cook in his second circumnavigation; and he took with him his son George, then 17 years old. For this undertaking Forster was abundantly qualified as a man of science and an accurate observer, though his temper and conduct were not always such as to make him agreeable to his shipmates, nor was he uniformly considerate and humane in his intercourse with the uncivilized inhabitants of the countries which he explored. After the return of the expedition, there were repeated discussions and disputes respecting Forster's share in the intended publication of the narrative of the voyage. Two thousand pounds, which had been granted by Government for the plates of the work, were to have been equally divided between Cook and Forster for this purpose; but Forster's performance of his part of the undertaking was disapproved, and he was deprived of the advantage which he expected to have derived from the plates. It is possible that he may have expressed himself incautiously respecting the conduct of the expedition; perhaps also he may have been thought deficient in accuracy of idiom; for he was more fluent, than correct or elegant, in the various languages which he was in the habit of speaking and writing. He was, however, supposed to be concern-

ed in the account of the voyage which was published by his son; and this participation was considered by his opponents, and even by many of his friends, as an infringement of the conditions of his engagement; besides that many offensive remarks and a few inaccuracies were introduced into the work, some of which were afterwards candidly admitted and corrected by his son. All these circumstances made Forster's residence in England by no means agreeable, and his pecuniary embarrassments became so pressing, that he was at one time in confinement for debt. He was, however, set at liberty in 1780 by the munificence of the King of Prussia, who furnished him with the means of satisfying his creditors, and established him at Halle, as Professor of Natural History, and Inspector of the Botanical Garden. The year after, he took the degree of Doctor of Physic in the university. He was not always on the most cordial terms with his academical colleagues, and he was too fond of accusing them in his reports to his superiors. His circumstances were also much embarrassed by his unfortunate propensity to play, which absorbed the whole earnings of his labour. He, however, considered the eighteen years that he spent at Halle as the happiest of his life. He was much afflicted in his old age by the premature death of his two sons; his health seemed to be impaired by his grief, and he died the 9th December 1798. Professor Kurt Sprengel has written an account of his life, containing a just encomium of his various talents and acquirements, though somewhat too flattering with regard to his moral character. He appears to have been master of seventeen different languages; and he was as extensively acquainted with things as with words; being as much indebted for his various knowledge to his industrious and accurate observation of nature, as to his great reading and his profound learning. He was long intimate with Buffon, and greatly admired his writings; and he was in constant correspondence with Linné and his son; the latter gave the name of *Forstera* to a new genus of plants, in compliment to the two botanists who had discovered it in New Zealand. In conversation he was witty, but frequently too satirical; and his unguarded sallies created him many enemies. He became a Fellow of the Society of Antiquaries soon after his arrival in England; in February 1772 he was elected a Fellow of the Royal Society; and, in 1775, upon his return from the South Seas, the University of Oxford conferred on him the honorary diploma of a Doctor of Laws. His principal publications are these:

1. *Specimen Historiæ Naturalis Volgensis, Ph. Tr.* 1767, p. 312, containing a geographical description of the country about Saratof, and an ample enumeration of its various productions. 2. *An Introduction to Mineralogy, or an accurate Classification of Fossils and Minerals,* 8vo. London, 1768; with a *Translation of* Lehman's *Halotechnia*, intended principally as a text book for a course of lectures delivered at Warrington. 3. *A Catalogue of British Insects,* 8vo. Warrington, 1770. 4. *A Translation of* Kalm's *Travels into North America,* 3 vols. 8vo. Warrington and London, 1770, 1771. 5. Osbeck's *Voyage to China and the East Indies, translated from the German; with a Faunula and Flora Sinensis,* 2 vols. 8vo. London, 1771. 6. *A Translation of* Bossu's *Travels in Louisiana, with Notes, and a Systematic Catalogue of all the known Plants of English North America; together, with an Abstract of* Löfling's *Travels,* 2 vols. 8vo. London, 1771. 7. *Novæ Species Insectorum,* Centuria I. 8vo. London, 1771; consisting chiefly of English insects, together with a few foreign ones, arranged according to the Linnean system, with the adoption of two genera from Geoffroy. 8. *An Account of the Management of Carp in Polish Prussia, Ph. Tr.* 1771, p. 310, in a letter to the Honourable Daines Barrington: it appears that the carp is a kind of staple commodity of that country. 9. *An Easy Method of Assaying and Classing Mineral Substances, with a Translation of* Scheele's *Experiments on Sparry Fluor, from the Memoirs of the Swedish Academy,* 8vo. London, 1772. 10. *Translation of* Bougainville's *Voyage,* 4to. London, 1772. 11. *Epistolae ad* J. D. Michaelis, 4to. Gotting. 1772, containing remarks on this author's Spicilegium Geographiae Exterae. 12. *An Account of the Roots used by the Indians in the neighbourhood of Hudson's Bay to dye Porcupines' quills, Phil. Tr.* 1772, p. 54; the Galium tinctorium, and Helleborus trifolius. 13. *An Account of several Quadrupeds from Hudson's Bay, Phil. Tr.* 1772, p. 370; describing a Collection of Specimens sent to the Royal Society from the Factory at Hudson's Bay. 14. *An Account of the Birds sent from Hudson's Bay,* p. 382. 15. *An Account of some Curious Fishes sent from Hudson's Bay, Phil. Tr.* 1773, p. 149, addressed to T. Pennant, Esq.: these papers were published during the author's absence with Captain Cook. 16. 17. He translated Grainger's *Travels* and Riedesel's *Travels* in conjunction with his son, George. 18. He made a *Catalogue of the Animals and Plants represented in Catesby's Carolina, with the Linnean names.* 19. *Characteres generum plantarum, quas in itinere ad insulas maris australis collegerunt* J. R. et G. Forster, folio, London, 1776; containing descriptions and figures of 75 new genera. 20. *Liber singularis, de Bysso antiquorum, quo ex Ægyptia lingua res vestiaria antiquorum, imprimis in sacro codice occurrens explicatur,* 8vo. London, 1776. The object of this essay is to prove, that the byssus of the ancients was cotton and not fine linen, in which the author succeeds without difficulty; and he states, that all the cloths enveloping the mummies, that he has been able to examine, are uniformly cotton. In his Egyptian etymologies he is learned and ingenious, but, like almost all other Egyptian etymologists, extremely precipitate. 21. *Observations, made during a Voyage Round the World, on Physical Geography, Natural History, and Ethic Philosophy, especially on the Earth and its Strata, Water, and the Ocean, the Atmosphere, the Changes of the Globe, Organic Bodies, and the Human Species,* 4to. London, 1778. This highly interesting work was published by subscription: a French translation of it was added as a 5th volume to that of Cook's Voyage, 4to. Paris, 1778. 22. *Description of the Yerbua Capensis, Swed. Trans.* 1778, p. 108. 23. *Translation of* Von Troil's *Letters on Iceland,* 8vo. London, 1780. 24. *On* Buffon's *Epochs of Nature, Götting. Mag.* 1780, I. i. p. 140. 25. *On the Tiger*

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Cat of the Cape, Phil. Tr. 1781, p. 1: the Felis Capensis, found from Congo to the Cape, and capable of being tamed like a cat. 26. *Historia Aptenodytæ, Commentat. Gott.* Vol. III. p. 121, the penguin, a genus peculiar to the southern hemisphere. 27. *Zoologia Indica Selecta,* Latin and German, fol. Halle, 1781, 4to. London, 1790; 2d edit. Halle, 1795. 28. *Account of a New Insect, Naturforscher,* Vol. XVII. p. 206, Halle, 1782; a species of cancer. 29. *A Picture of England for* 1780, *continued to* 1783, 8vo, 1784. German, 8vo. Dessau, 1784, giving some amusing particulars of many of the principal public characters at the time of the American war, but frequently satirical, and sometimes unjust. 30. *Essays on Moral and Physical Geography,* 3 vols. 8vo. Leipsic, 1781, 1783; continued by his son-in-law, Matthias Sprengel. 31. *A Collection of Memoirs relating to Domestic Economy and Technology,* 8vo. Halle, 1784. 32. *On the Albatross, Mém. Sav. étr.* Vol. X. p. 563; the Diomedea. 33. *History of Discoveries and Voyages in the North,* 8vo. Frankfort on the Oder, 1784, English, London, 1786, Fr. Paris, 1788; containing a most extensive and elaborate collection of relations of all the attempts that had been made to explore the Arctic regions. 34. *Project for abolishing Mendicity, especially at Halle,* 8vo. Halle, 1786. 35. *Enchiridion Historiæ Naturali inserviens,* 8vo. Halle, 1788; an extremely useful collection of definitions of the terms employed in the description of birds, fishes, insects, and plants, after the manner of the *Philosophia Botanica* of Linné; it is dedicated to his son George, by whose infantine curiosity he was first impelled to the study of natural history; and it was chiefly arranged during the leisure hours of his voyage round the world. 36. *A Memoir on the Badjar Cit. Mém. Acad. Berl.* 1788, 1789, p. 90: the Manis pentadactylus. 37. *Magazine of Modern Voyages and Travels, translated from various languages, with remarks,* 16 vols. 8vo. Halle, 1790, 1798. 38. An edition of *Bergius über die Leckereyen,* a work on diet, with notes by Forster, Kurt, and Sprengel, 2 vols. 8vo. Halle, 1792. 39. *A Letter to Schreber on the Persea, Magazin fur die Botanik,* Vol. V. p. 234. 40. *Onomatologia nova systematis oryctognosiæ vocabulis Latinis expressa,* folio, Hal. 1795, 1 page. 41. *Observations and Truths united to Probabilities, or Materials for a new Essay on the Theory of the Earth,* 8vo. Leipzig, 1798: one of the last of our author's publications, which is considered as a good elementary work on geology.

(Sprengel's *Memoir,* Eyries *in Biographie Universelle,* Vol. XV. 8vo. Paris, 1816. Aikin's *General Biography,* Vol. IV. 4to. London, 1803. Chalmers's *Biographical Dictionary,* Vol. XIII. 8vo. London, 1814.) N. A.

FORSTER (JOHN GEORGE ADAM), commonly called GEORGE, a distinguished naturalist and circumnavigator, son of John Reinhold Forster, was born at Dantzic in 1754, and enjoyed, in his earliest youth, the advantage of his father's assiduous and affectionate instructions, by which he profited so rapidly, that he was capable, at the age of ten years, when he went with his father into Russia, of ascertaining the species of a plant, by comparing it with the Linnean description. He was for a short time at a school in Petersburg. Upon his arrival in London, he was at first placed in a merchant's counting-house, but soon found his health unequal to the employment, and followed his father to Warrington, where he continued his studies at the academy with so much application, that he became perfect master of the English language, and otherwise distinguished himself by the strength of his memory and the vigour of his imagination; at the same time that he assisted his father in giving lessons in French, and in completing a variety of translations of voyages and travels. He also accompanied his father, together with Sparrman, in the arduous engagement of making all kinds of physical observations in the circumnavigation of the globe, and he was particularly employed in delineating the various objects of natural history which were discovered. After his return he was elected a Fellow of the Royal Society; but he soon quitted England to settle at Paris. In 1779, however, he was appointed Professor of Natural History at Cassel; and, in 1784, he was nominated to a similar situation in the University of Wilna, where he took a degree of doctor of physic; but he found little satisfaction in residing among a people so imperfectly civilized. The Empress of Russia had engaged him to take an important part in a new voyage of discovery which she meditated; but the design was abandoned upon the commencement of the war with the Turks. He was next invited by the Elector of Mentz to accept the appointment of President of the University, newly established in that city, and he was residing there at the time that the French army entered it. Being a declared republican in his political principles, he was dispatched as an envoy to Paris, to solicit the incorporation of Mentz with the French Republic; but during his absence, the Prussian troops retook the city, and he lost the whole of his property, including his numerous manuscripts. He had married a Miss Theresa Hayne, and had one daughter as early as 1788; but, at a subsequent period, his wife's conduct gave him great reason for uneasiness, and though he affected to despise what he called the prejudices of social life, and to excuse her infidelity, and even attempted to facilitate her union with a more favoured admirer, still the affair in reality affected him deeply, and he resolved once more to leave Europe, as if in search of the waters of oblivion; he was actually preparing for a voyage to Tibet, when his health was subdued by the ravages of a scorbutic disorder, and he died on the 13th February 1792. Besides the assistance which he rendered his father in many of his literary undertakings, he was also the author of a variety of separate publications under his own name.

1. *A Voyage Round the World in his Britannic Majesty's Ship Resolution, commanded by* Captain James Cook, *during the years* 1772, 1773, 1774, and 1775, 2 vols. 4to. London, 1777. In German, 2 vols. 4to. Berlin, 1779–1780; 3 vols. 8vo. 1784. The style of this work is rather more animated and poetical than that of the official account of the voyage; the second volume is considered as the best written, and the freest from affectation and false sentiment. 2. Mr Wales, the astronomer of the expedition, pub-

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lished some remarks on the work, which occasioned a *Reply to* Mr Wales's *Remarks*, 8vo. London, 1778, in which the author declares, that his father had no concern whatever in the book, but admits that he had committed some few inaccuracies. 3. *A Letter to the* Earl of Sandwich, 4to. London, 1779. 4. His *Answer to the Authors of the Literary Journal of Gottingen* exhibits considerable warmth of language, but candidly admits some errors: it excited some further animadversions from Professor Meiners, who declared himself the author of the criticisms. 5. In 1787, he published at Berlin, in 4to, *A Translation of* Captain Cook's *Third Voyage, performed in* 1776–1780, with an introduction and other additions. 6. *A Description of the Gentiana saxosa. Swedish Trans.* 1777, p. 183. 7. *Life of* Dr Dodd, 8vo. Berlin, 1779. 8. *Preface to* Sparrman's *Travels*, 8vo. Berlin, 1784. 9. He undertook, together with Professor Lichtenberg, the publication of the *Gottingen Magazine*, which was continued from 1780 to 1785, and published in it, among other essays, *A Description of the Red Creeper, or Certhia coccinea of Owhyhee*, I. vi. p. 346. 10. *Experiments with Vital Air*, Vol. III. ii. p. 281; examining its effects on glow-worms. 11. *A Decad of New Plants.* N. Act. Upsal. Vol. III. 1780, p. 171. 12. *On Pygmies*, Hessiche Beyträge. Vol. I. p. 1, 1785. 13. *History and Description of the Bread Fruit Tree*, p. 208, 384; also separately, 4to. Cassel, 1784. 14. *Florulæ Insularum Australium Prodromus*, 8vo. Gottingen, 1786. 15. *Fasciculus Plantarum Magellanicarum, Commentat. Soc. Gott.* Vol. IX. p. 13. 16. *Plantæ Atlanticæ*, p. 46. 17. *Miscellanies, or Essays on Moral and Physical Geography, Natural History, and Moral Philosophy*, 6 vols. 8vo. Leipsic and Berlin, 1789–1797; the two last volumes are posthumous, and chiefly of a political nature. 18. *Picture of the Lower Rhine, Brabant, Flanders, Holland, England, and France*, taken in the year 1790, 3 vols. 8vo. Berlin, 1791–1794. Dutch, Haarlem, 1792, 1793. French, called *Voyage Philosophique*, 2 vols. 8vo. Paris, 1795, 1796. This work contains many interesting remarks on manners and on the arts, showing that the author possessed very extensive information, as well as originality of talent; but there is too much affectation of sentiment, and an injudicious display of hostility to Great Britain. 19. *Historical Remembrances of the Year* 1790, 8vo. Berlin, 1793. There are also several political pamphlets of a temporary nature, which could add little or nothing to their author's fame; and a few scattered memoirs in different periodical publications. He was also concerned in the *Collection of Voyages*, published by Professor Sprengel; and, together with Pallas and others, in an edition of Martini's *Dictionary of Natural History.* Indeed, his life, though short, was one continued scene of literary activity; but his application to the labour of compilation was too unremitting to allow him to concentrate the whole force of his mind on the performance of any one great original work of genius. The *Sketches of the Mythology and Customs of the Hindoos* were written by another author of the same name.

(*Life by* Pougens. *J. R. Forster in* Jacobi's *Annals, and in the Dedication of his Enchiridion.* Eyries *in Biographie Universelle*, Vol. XV. 8vo. Paris, 1816. Aikin's *General Biography*, Vol. IV. 4to. London, 1808. Chalmers's *Biographical Dictionary*, Vol. XIII. 8vo. London, 1814.) (M. E.)

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FOURCROY (ANTONY FRANCIS DE), a celebrated chemist and physician, born at Paris 15th June 1755, was the son of John Michael de Fourcroy, by his marriage with Jane Laugier. His family had been long established in the capital; several of them had been distinguished at the Bar, and Fourcroy de Ramceourt was well known as an engineer of considerable talent, and a Member of the Academy of Sciences.

His father was an apothecary, attached to the household of the Duke of Orleans, and was a great sufferer by the abolition of places of this kind, which was procured by the corporation of apothecaries, some time before the revolution. Young Fourcroy was sent to the College of Harcourt, but made no progress in his learning there, and underwent great hardships from the cruelty of an unjust master. He was afterwards obliged to subsist by his labour in copying, and by taking pupils as a writing master. He was, however, fortunate in the patronage and assistance of Vicq d'Azyr, who had been a friend of his father, and under whose auspices he resolved to study physic, obtaining his support in the meantime by giving his assistance to richer persons than himself in their literary labours, and by a few translations, for which he was very ill paid. When he had gone through the regular course of study, he became a candidate for a gratuitous diploma, upon a foundation established by Dr Diest; but he failed of success from a party quarrel. His own party, however, which was that of Vicq d'Azyr, indemnified him for the loss, by making a collection to discharge the fees, amounting to about L. 250; but the highest degree, that of Doctor Regent, was still refused him, and he was therefore incapable of holding a Professorship under the Parisian Faculty of Physic. He resolved to apply himself to science as the readiest way of acquiring medical reputation, but he seems to have been little known, at any time of his life, as a practical physician. The determination, however, like that of the countryman in the fable, was still a beneficial one, and though he failed of discovering the golden treasure for which he dug, he profited by the increased fertility of the soil, and by the abundant fruits which it bore him.

In natural history he soon distinguished himself as a pupil worthy of Geoffroy, by an entomological publication; in anatomy, by his description of the tendons and their sheaths, which appears to have procured his admission into the Academy of Sciences in 1785; he stood at first in the capacity of an anatomist, though he was afterward removed to the section of chemistry. His favourite pursuit, however, from the beginning, was chemistry, and in this he derived considerable assistance from Bucquet, who was then a professor in great esteem; and having once undertaken to deliver a lecture in his place, on occasion of a temporary indisposition of Bucquet, though wholly unprepared, he found himself capable of speaking for two hours with great fluency, to the delight and astonishment of his audience. The re-

Fourcroy. putation of Bucquet was soon transferred to Fourcroy, and he was enabled, by an advantageous marriage, to purchase the apparatus of his predecessor, and to succeed to his lectures.

In 1784, on the death of Macquer, then Professor of Chemistry in the Royal Garden, the Count de Buffon found the claims of Fourcroy so strong, that he thought it right to appoint him to the vacant chair, though no less a chemist than Lavoiser was a rival candidate; the competition not being wholly decided either by talent or by depth of learning, but probably, in great measure, by the reputation in the art of teaching which Fourcroy had already acquired. His success in this new situation was brilliant and universal; and he continued for twenty five years to absorb the whole attention of a numerous audience by his eloquence, and by the perspicuity of his mode of explaining some of the most important novelties that have ever appeared in any age. The science which he taught was then making its most rapid progress. It was then that Bergman and Scheele had introduced into analytical chemistry a precision almost geometrical; that Priestley had discovered the aeriform elements of the animal and vegetable world; that Black and Wilcke had methodised the phenomena of heat; that Cavendish had discovered the composition of water and of the nitric acid; that Monge had repeated and extended his experiments; and that Lavoisier had reduced the whole of chemistry to a uniform system, which, though founded on a generalisation somewhat too hasty, has still been of important service to the science, by concentrating the attention of the philosophic reasoner on various classes of phenomena, which could not so easily have been comprehended in one view, without the aid of some such hypothesis. Mr De Fourcroy was particularly happy in his tact of perceiving, whether or no all his audience were fully in possession of the ideas he wished to communicate to them, and he was never tired of explaining himself, till he was satisfied that he had said enough. His manner was energetic, and such as an Englishman might perhaps have thought pompous and affected; but we must recollect, that there is no fixed standard of propriety in matters of taste, and that, as the common conversation of the French is naturally accompanied with more of emphasis and gesture than our own, it is very possible, that without any greater proportional exaggeration than is introduced in similar cases in Great Britain, an actor, a lecturer, or a preacher, may exhibit what to us would appear a caricature, while it only affects his own countrymen as a natural, though impressive, style of public speaking. The chemical amphitheatre of the Public Garden was crowded by students from all countries, and from all quarters of the globe, some prompted to visit Paris by their own love of learning only, some assisted in their pursuits by their respective governments; and it was twice in succession necessary to provide more extensive accommodations for the overflowing numbers that sought for admittance.

Mr De Fourcroy's political life, though not unsuccessful, seems to have contributed less materially to his happiness, than his scientific career. He was chosen a supplementary member of the National Convention, and entered on the functions of the office in the dreadful period of 1793. He had, however, the wisdom to refrain from employing the eloquence that he possessed under circumstances so dangerous, and he almost entirely confined his exertions to some attempts to soften the cruel tyranny of the times. Darcet was one of the destined victims that he had the good fortune to save; but he soon found it too dangerous to persist in such interferences. Mr Cuvier, however, very fully acquits him of any approbation of the judicial murders that were committed, and of any connivance at such proceedings as it might have been possible for him to avert; declaring, that if, upon the strictest inquiry, he could have discovered that there was the least foundation for charging him with having been indifferent to the fate of his great rival Lavoisier, no consideration on earth could have induced him to become the biographer of a person so contemptible. It was at a later period, that Fourcroy acquired some little influence as a director of the public instruction; and in this capacity he had great scope for the exertion of his talents, in the re-establishment of the many public institutions connected with science, which the madness of the revolution had destroyed. The *Ecole de Médecine* was one of the first that was restored, but the name of Médecin seeming to carry with it too much of respect and authority for the levelling spirit of the day, the new institution was at first called *Ecole de Santé*. M. de Fourcroy was also very essentially concerned in the organization of the *Ecole Polytechnique*, as well as of the central schools of the departments, and of the *Normal* schools of Paris; nor was he an indifferent spectator of the establishment of the *Institute*, which was at first intended to be as much immediately subservient to public instruction, as to making known the results of private study. He had also considerable influence in obtaining the adoption of a law, calculated greatly to facilitate the formation of a Museum of Natural History of a magnificent extent. If, in the pursuit of these objects, he sometimes appeared to forget the dignity of language most appropriate to his subject, it must be remembered, that he lived in times when the choice of expressions was by no means at the option of the speaker. He was once denounced by the Jacobins, merely for his silence in the Assembly; but he excused himself, by pleading the absolute necessity of applying himself to chemical pursuits for the support of his family.

In 1798 his duties as a senator were terminated, but he was made a counsellor of state under the consular government, and again employed in the department of public instruction, with less liberty to pursue his own ideas than before, but with more effectual means of attaining the objects of his appointment. In this capacity he directed, in the course of five years, the establishment of 12 schools of law, and of more than 30 lyceums, now called Royal Colleges, and 300 elementary schools; exhibiting, in the performance of this laborious duty, the greatest possible judgment and attention, in overcoming the local difficulties which perpetually occurred in the details of the undertaking, and depending on none

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but himself for the whole of the required arrangements: he conducted himself with great impartiality in his choice of the persons to be employed, though he sometimes found himself obliged to pay a certain degree of deference to the arbitrary power under which he acted, or even to his own political connexions. Remembering the difficulties which he had himself encountered in the early part of his career, he was particularly kind and benevolent in his intercourse with those young men, to whom he was the dispenser of the public munificence, in admitting them to a gratuitous education.

The great number and extent of Mr de Fourcroy's scientific labours may be considered as paramount to a more immediate participation, in the discovery of some of the new facts, which changed the aspect of the science of chemistry. His ideas were, however, often rather enlarged than profound, and he was not uncommonly somewhat too precipitate in his conclusions; but he was generally methodical in the mode of conducting his researches, and clear in relating their results. His pursuits and projects were sometimes varied a little capriciously, though he prosecuted them all with equal warmth and equal eloquence. He was too much the slave of public opinion for his own comfort, and even the slightest expression of censure that occurred in private society, or the most unimportant criticism that appeared in a periodical work, became a heavy misfortune to him, and deprived him of his tranquillity for a considerable time. But the desire of universal approbation acted upon him as a strong incentive to continued exertion; and among all his political and his official labours, he continued his experiments, his memoirs, and his lectures, with as much eagerness as if they had constituted his whole occupation. His nerves seem ultimately to have suffered by his unremitting application, and he became subject to palpitations, which, as he was well aware, rendered the duration of his life extremely precarious. At last, on the 16th December 1809, at the age of 54, as he was signing some dispatches, he exclaimed suddenly, " I am dead;" and his words were true. It happened, that on that day his family were about to assemble for the celebration of an anniversary, in which they were particularly interested; the assembly actually met, though only to mourn his loss: and their disappointment was rendered the greater, upon the receipt of some distinguished marks of the imperial favour, which arrived too late to be of any use to his spirits or to his health, but which would have been of the more value to him, as he had before been passed over, when some of his collegues had received considerable gratifications. He had, however, been made a Count of the Empire, and a Commander of the Legion of Honour, in addition to his various literary and scientific titles; and he must have had the heartfelt satisfaction of reflecting, that he had been of use to the promotion of knowledge by his experiments and his writings; to his country by the public institutions which he had established; and to many deserving individuals by the benefits which he had bestowed on them, without the remorse of having done injury to any one.

He left a son by his first marriage with Mlle Bettinger, the Count de Fourcroy, an officer of artillery, who was afterwards killed in the campaign of 1813 in Saxony, and a daughter, Mad. Foucaud. By his second marriage, with Mad. Belleville, the widow of M. de Wailly, he had no children. His two maiden sisters also survived him, by no means in a state of affluence, and they received great kindness from his friend and assistant Mr Vauquelin. His place at the Institute was very ably filled by Mr Thenard; Mr Laugier succeeded him at the Museum, and Mr Gay Lussac at the *Ecole Polytechnique.*

The chief of Mr de Fourcroy's separate publications are, 1. *Essai sur les maladies des artisans.* 12. Paris, 1777, translated from Ramazzini. 2. *Analyse chimique de l'eau sulfureuse d'Enghien*, par Fourcroy et Laporte, 8vo. 1778, applying the recent discoveries on the nature of gases to the contents of this water. 3. *Leçons élémentaires d'histoire naturelle et de chimie.* 2 vols. 8vo. 1782. 5 vols 8vo. 1789, 1794; afterwards translated by Nicholson. 4. *Mémoires et observations de chimie.* 8vo. 1784; a collection of memoirs intended as a sequel to the elements; most of them had been read to the academy before the author was a member, and destined for the *Mémoires des Savans Etrangers;* they relate to the metallic carbonates, to detonations, to tests for water, to combustions in a stream of oxygen, and to the properties of several saline and metallic substances, with a useful introduction on the mode of conducting chemical experiments. 5. An edition of the *Entomologia Parisiensis of Geoffroy.* 2 vols. 12mo. 1780; extracted from Geoffroy's larger work, with the addition of 250 new species. 6. *L'Art de connaitre et d'employer les médicamens dans les maladies.* 2 vols. 8vo. 1785. 7. *Méthode de nomenclature chimique*, par de Morveau, Lavoisier, Berthollet, et de Fourcroy. 8vo. 1787. 8. *Essai sur le phlogistique et les acides.* 8vo. 1788; from the English of Kirwan. 9. *La Médecine éclairée par les sciences physiques.* 4 vols. 8vo. 1791, 1792; a collection of papers, with some original essays by the editor. 10. *Philosophie chimique, ou vérités fondamentales de la chimie moderne.* 1792, 1796, 1800. Reviewed by Deyeux, *Ann. Ch.* LVI.; a work which has been translated into almost every European language, including modern Greek. 11. *Procedés pour extraire la soude du sel marin.* 4to. 1795. 12. *Systéme de connaisances chimiques.* 10 vols. 8vo. 5 vols. 4to. 1800. This vast collection of chemical information was written from beginning to end in the space of eighteen months, during an interval of leisure from public business. *Rev. Ann. Ch.* XXXVI. XXXVII. Translated by Nicholson. 13. *Tableaux synoptiques de chimie.* folio, 1800, 1805. 14. *Abregé de chimie, pour l'usage des écoles vétérinaires.* 15. *Chimie pour les Dames*, in the *Bibliothèque des Dames.*

Besides his separate works, Mr de Fourcroy was the author of more than 160 *Memoirs*, printed in different publications, the principal of which it will be sufficient to enumerate in a very cursory manner, adding a few of Dr Thomson's able criticisms on the respective articles. The most important of his later researches were published jointly in his own name and in that of his pupil Vauquelin; and it is supposed that the processes were generally conducted and often suggested by Vauquelin, but that the in-

Fourcroy. vestigations were set on foot and directed, and the results described and methodized, with inferences and theoretical reasoning, by Fourcroy.

16. In the *Memoirs of the Academy of Sciences*, we find an *Anatomical history of the tendons and their mucous capsules*, 1785, 1786, 1787. 17. *On the smoking oil of vitriol of Saxony, and the concrete salt obtained from it*, 1785: modifications of the sulfurous acid. 18. *On hepatic gas*, 1786. 19. *Report on a sand from Peru containing copper*. 20. *On azote, and its production in animals*, 1787. 21. *On detecting lead in wines*, 1787. 22. *On combustions in the oxymuriatic acid*, 1788. 23. *On metals precipitated by ammonia*, 1788. 24. *Experiments on animal substances made at the Lyceum*, 1789. 25. *On a liver changed by putrefaction*, 1789, 26. *On the colours derived by vegetables from oxygen*, 1789. 27. *On an ore of lead from Roziers*, 1789. 28. *On the sulfate of mercury, and on triple ammoniacal salts*, 1790. 29. *On the formation of the nitric acid by the action of the oxyd of mercury on ammonia*, 1790. 30. *On the combustion of hydrogen in close vessels*, by Fourcroy, Vauquelin, and Séguin, 1790. 31. *On barita and strontia*, *Mem. Inst.* Vol. II. 1797. 32. *On phosphate of lime and on phosphorus*, Ib. 33. *On the urinary secretion in horses and in the human subject*, Ib. 34-36. *On urinary calculi, with two more memoirs on the secretion*, IV. 1803. 37. *On the nitrous oxyd*, by Fourcroy, Vauquelin and Thenard, VI. 1806. 38. *On cow's milk*, Ib. 39. *On the guano, used as a manure in the South Sea Islands*, Ib. 40. *On tabasheer*, Ib. 41. *On the chemical nature of carious wheat*, Ib.; the change is supposed to depend on an alteration and depravation of the gluten. 42. *On a detonating substance obtained from indigo*, Ib. 43. *On animal substances treated by nitric acid*. Ib. 44. 45. *Two memoirs on crude platina and a new metal found with it*. 46. *On the effects of germination and fermentation on corn and pulse*, VII. 1801. 47. In the *Memoirs of the Royal Society of Medicine for* 1782-3-4, Par. 1787, we find a valuable memoir *On the Muriate of Lime*, p. 267, which the author seems to have been one of the first to introduce in such cases as had usually been benefited by sea water. 48. *On morbid changes in some of the Animal Fluids*, p. 488. 49. *On the nature of muscular fibres, and on the seat of irritability;* showing the analogy of muscular fibre to the coagulable lymph of the blood, and observing that Bordeu had very properly called the blood a fluid muscle.

Many of these earlier papers have also been printed in the *Annales de Chimie*, but they are sometimes altered, and they are mixed with others, which are original. 50. *On Azote*, (20), Vol. I. (1789). This memoir exhibits no very favourable specimen of the author's accuracy; for he asserts in it that pure azote turns vegetable blues to green, and that it may be obtained by means of a low heat, from the oxyd of manganese. 51. *On the gas in the air vessels of the carp*. 52. *On a morbid change in the blood*, Ib.; exuding from the face. 53. *On detecting lead in wine* (21) Ib. 54, 55. *On two ores of lead*, II.; containing the arseniate and the phosphate. 56. *On the action of oxyds on ammonia*, Ib.; particularly those of manganese, mercury, and tin. 57. *On the salts of magnesia*, Ib. 58. *On a change in the liver after death*, (25), III. 59. *On biliary calculi*, Ib.; describing the adipocere of these substances. 60. *On the albumen of vegetables*, Ib. more properly distinguished by Proust under the name of gluten. 61. *On the carbonate of barita of Alston Moor*, IV. 62. *On the medical properties of oxygen*, Ib. 63. *On the triple salts of ammonia and magnesia*, Ib.; an elaborate and interesting paper. 34. *On combustions in oxymuriatic acid gas*, Ib. 65. *On the effect of oxygen in colouring vegetables, and on the preparation of solid pigments*, V. 66. *On the changes observed iu the cemetery of the Innocens*, Ib. Fourcroy had been appointed, together with Thouret, to superintend the removal of these remains to a remoter spot, and observed that the muscular parts were often slowly changed into a substance nearly resembling spermaceti. 67. *On a black sand from St Domingo*, VI. 68. *On the water of Enghien*, (2). Ib. 69. *Discoveries in animal and vegetable chemistry*, Ib. 70. *On the formation of the nitric acid from the action of the oxyd of mercury on ammonia*, (29). Ib. 71. *On the culture of cloves in the Isle of Bourbon*, VII. 72. *Experiments on animal substances, made at the Lyceum, in* 1790, (24). Ib. 73. *Second memoir on the substances found in the cemetery*. 74. *On the cinchona of St Domingo*, VIII. X.; a very valuable analysis of a species of bark officially referred to his examination. 75. *On the combustion of hydrogen*, (30). VIII. 76. *Report on Loyser's art de la verrerie*, IX. 77. *On bell metal*, Ib.; the principal object of this paper is to discover a ready mode of converting the spoils of the churches into copper coin, by fully oxydating a part of the alloy, and fusing the remainder with it; the whole of the tin becomes oxydated, and the copper is melted out in a state of purity. 78. *On tears and mucus*, X.; a valuable investigation of the nature of the substances most generally diffused in the animal fluids. 75. *On the sulfate of mercury and its combination with ammonia*, Ib. a paper containing several new facts, though mixed with some inconclusive reasoning. 80. *On the refinement of saltpetre*, XI. 81. *On the juice which furnishes elastic gum*, Ib. 82. *Note on the decomposition of the carbonic acid gas, effected by Mr Tennant*, XII. 83. *On triple salts*, XIII. 84. *On animal concretions*, from the *Dictionnaire Encyclopédique*. 85. *On the brain*, XVI. 86. *Report on some artificial pencils*, XX. 87. *Extract of a Memoir on hydrocarbonous gas, and on the supposed combustion of azote*, XXI; showing that, though phosphorus is soluble in azote, it is only so far burned in it as some particles of oxygen happen to be present. 88. *On detonations by percussion*, Ib. 89. *Extract of a memoir of Proust, on odoriferous substances*, Ib.: Mr de Fourcroy proved the non-existence of any separate principle deserving the name of aroma, and showed that odorous substances, in general, were volatilised without any change of their nature, or separation of their parts. 90. *On obtaining pure barita*, Ib.; an elegant and effectual process. 91. *On the union of chemistry mith pharmacy*, Ib. 92. *On vitality, and on Humboldt's experiments*, XXII. 93. *On the action of the sulfuric acid on vegetable and animal substances*, XXIII. 94. *On the formation of the sulfuric Ether*, Ib. Fourcroy.

This paper seems to make it probable that the attraction of the acid for water tends to facilitate the formation of the ether in this instance, though the same theory cannot be applied to the action of the other acids on alcohol. 95. *On the sulfurous acid*, XXIV. 96. *Report on some colours for porcelain*, XXV. 97. *Letter to Humboldt, on the chemistry of Life*, XXVII. 98. *Examination of Dr Pearson's experiments on calculi*, Ib., with a general request to medical men, soliciting the communication of specimens. 99. *On pneumatic medicine*, XXVIII. 100. *On the experiments of Mayow*, from the *Dictionnaire Encyclopédique*, XXIX. 101. *Novelties from Egypt*, Ib. 102. *On congelation by artificial cold*, Ib. 102. *Letter to Giobert on calculi*, XXX. 103. *Notice of Venténat's vegetable system*, Ib.: this botanist has given to an elegant genus of plants the name of Furcroea, in compliment to the merits of our author in natural history. 104. *On the chemical and medical history of the urinary secretion*, XXXI. XXXII.; finding some of the peculiar substances which occur in the human subject to be identical with some of the contents of the excretions of birds, though they are wanting in the same fluid formed by quadrupeds. Mr de Fourcroy had ascertained that some of the calculi found in animals were capable of being dissolved by a weak solution of vinegar, and he had conceived some hopes that the observation might be applied with advantage to similar diseases in the human subject. His investigations respecting calculi, however, notwithstanding their importance, were in great measure anticipated by the acute penetration of our celebrated countryman Dr Wollaston, though his paper is not mentioned by Mr. de Fourcroy. 105. *Notice of the chimie optomathique*, XXXI. 106. *Account of a memoir of Fabroni on fermentation and on ether*, Ib. 107. *Chemical novelties*, XXXII. 108. *Report on Paul's artificial waters*, XXXIII. 109. *On Dabit's ether*, XXXIV. 110. *On the identity of the three empyreumatic acids with the acetic*, XXXV.; suggesting that they might be substituted for it in some economical processes. 111. *Galvanic experiments*, XXXIX; by Fourcroy, Vauquelin, and Thenard. 112. *Note in answer to Proust*, XLII. 113. *Remarks on a memoir of the Dutch chemists on the carbonic oxide*, XLIII. 114. *On a new phosphate found in the bones*, XLVII.; that of magnesia, not before observed. 115. *Extract of a memoir on platina*, XLVIII. 116. 117. *Two memoirs on crude platina, and on a metal found with it*, XLIX, L. These researches were less successful than those of Mr Tennant, Dr Wollaston, and Mr. Descorils, which were completed about the same period. 118. *Extract from Izarn's manual of galvanism*, L. 119. *On the alumina of Saxony*, LII. 120. *On a fluid found in the caoutchouc of the Castilloya elastica*, LV. 121. *On a detonating substance formed by the action of the nitric acid on indigo and animal matters*, LV.; the investigations relating to indigo have since been carried further by Mr Hatchett. 122. *On the products of animal substances treated with the nitric acid*, LVI.; yielding more azote as they are more highly animalized. 123. *On the guano*, (39), LVI. 124. *Experiments on ivory, recent and fossil, and on the enamel of the teeth, in search of the fluoric acid*, LVII.; these experiments were not completely successful, though Morichini had detected the fluoric acid in the teeth before that time, and Berzelius has found it still more recently.

Mr de Fourcroy was for some years the editor of the *Journal des Pharmaciens*; he first suggested the idea of the publication of the *Annales du Muséum d'Histoire Naturelle*, and contributed several valuable papers to it, as well as to the *Journal de l'Ecole Polytechnique*, and to the *Magazin Encyclopédique*. He was also the author of some very voluminous articles in the chemical part of the *Encyclopédie Méthodique*; but the fabric of his celebrity is principally founded on the works which have already been enumerated, and which are better known to the public.

(Palissot de Beauvois *Eloge Historique*. Par. 1810. Cuvier *Eloge*, M. Inst. A. Math. 1810; and in *Biographie Universelle*, XV. 8. Par. 1816. Thomson's *Annals*, I. May 1818, p. 321. Aikin's *General Biography*, Vol. X. 4to. Lond. 1815.) (X. A.)

FOX (the Right Honourable CHARLES JAMES) was third son of the Right Honourable Henry Fox, afterwards Lord Holland, and of Lady Georgina Caroline Fox, eldest daughter of Charles, second Duke of Richmond. He was born January 24, 1749. (N. S.).

Mr Fox received the first rudiments of his education in a private school of some celebrity kept by a Mr Pampelune at Wandsworth. In 1758 he was sent to Eton, where he gave early promise of his future eminence. In the beginning of summer 1763 the mistaken indulgence of his father carried him first to Paris, and then to Spa. After wasting idly three months abroad he was sent home to England, and at his own desire, he went back to Eton. He had left school a boy; he returned to it with all the follies and fopperies of a young man. At Spa he had been initiated in play, and his father, whose fondness for him was excessive, had encouraged him in a propensity, which was the source of much future unhappiness to both.

In autumn 1764 he was removed from Eton and sent to Oxford, where he was placed at Hertford College under the tuition of Dr Newcome, afterwards Primate of Ireland. At Oxford as well as at Eton he distinguished himself, not less by his powers of application, than by the quickness and superiority of his parts. The following letter, which he preserved with care, and used to show with triumph, when reproached for idleness, is a curious document of his diligence in study while he was at college. "You judge rightly," says Dr Newcome in a letter to his pupil, "in thinking that I should be much surprised by the information which you were so obliging as to give me. But, on reflection, I think you have done well to change the scene in such a manner, and I feel myself inclined to envy you the power of doing it. Application like your's requires some intermission; and you are the only person with whom I have ever had connection to whom I could say this. I expect that

you will return with much keenness for Greek, and for lines and angles. As to trigonometry, it is matter of entire indifference to the other geometricians of the college (who will probably continue some time here), whether they proceed to other branches of mathematics immediately, or wait a term or two longer. You need not, therefore, interrupt your amusements with severe studies; for it is wholly unnecessary to take a step onwards without you, and therefore we shall stop till we have the pleasure of your company. All your acquaintances here whom I know are well, but not much happier for your absence." This letter was probably written in spring 1765, when Mr Fox made a second excursion to Paris with his mother.

In autumn 1766 he quitted Oxford, and accompanied his father and mother to the south of Europe, where Lord Holland had been advised to pass the winter on account of his health. He remained with them at Naples during the winter, and not finding a good Italian master there, taught himself that language. In the following spring he attended them as far as Turin in their way to England, and then went to Genoa to meet Lord Fitzwilliam, with whom and Mr Uvedale Price he spent the summer in Italy, chiefly in Tuscany. In the beginning of winter he rejoined his father and mother at Paris, and accompanied them to Nice, where he passed with them the winter of 1767-8. It was during this long residence in Italy that he contracted his strong partiality for Italian literature. In a letter to Mr Fitzpatrick, written from Florence in September 1767, he conjures him to learn Italian as fast as he can, if it were only to read Ariosto. "There is more good poetry in Italian than in all other languages I understand put together." He appears to have indulged freely at this period in all the pleasures natural to his time of life, but never to have intermitted entirely his application to study. *Je travaille toujours le matin*, he says in another letter written from Nice. Acting plays was also at this time one of his favourite passions, though he confesses that the last time he acted, he fell far short of his own expectations; "but then," he adds, "my expectations, it must be confessed, were very high." In the course of this journey he made a visit to Voltaire at Fernay in company with Mr Price.

He did not return to England till August 1768; and having been elected one of the burgesses for Midhurst in his absence, he took his seat in the ensuing session, and made his first speech in the House of Commons, on the 15th of April 1769, in support of the decision in favour of Colonel Luttrel on the famous Middlesex election. He spoke, says Horace Walpole, with insolence, but with infinite superiority of parts.

Lord Holland, father to Mr Fox, had begun his political career as an adherent of Sir Robert Walpole, and continued ever after one of the steadiest friends and warmest admirers of that great statesman. The treachery of the Pelhams to his patron excited an early prejudice in his mind against all the members of that family, and the falseness, folly, and fickleness of the Duke of Newcastle added contempt and distrust to his dislike. After a long rivalship with Mr Pitt, he was finally driven from the Cabinet by a coalition of the Pitt and Newcastle parties, and reduced to the subordinate, though lucrative employment, of Paymaster of the Forces. In this situation he was found by Lord Bute at the conclusion of the war, and recommended to the King as the only person in the House of Commons who had courage and ability to defend the peace against Mr Pitt and the Newcastle party. It was with great difficulty he was prevailed on by his Majesty to undertake this office, but when engaged in it, he performed it most successfully. For his services, on this occasion, he was rewarded with a peerage; but the part he had taken estranged him for ever from his old friends, the Dukes of Cumberland and Devonshire, and other leaders of the Whig party. It was at this period that his son Charles received his first political impressions, and there is still extant a copy of French verses written by him in 1764, in praise of Lord Bute, and full of invective against Mr Pitt. When brought into Parliament, he was, therefore, in the first instance, connected with the Duke of Grafton's administration, which, though originally formed under the auspices of Lord Chatham, had been gradually sinking into a mere Court party.

Mr Fox was not of age when returned to Parliament, and probably for that reason, after his first speech, he took little part in public debate till January 1770. During this interval he made another excursion to the Continent, where he is chiefly taken notice of for his losses at play. He had, as already mentioned, acquired a passion for play as early as his first journey to Spa; and for many years afterwards, when not engaged in active political business, play and Newmarket were his chief avocations. His losses were such as early to embarrass, and finally to ruin, his private fortune; but so great a hold had these pursuits taken of his mind, that, till the payment of his debts in 1794, he could never prevail on himself to renounce them entirely. From that moment he gave them up for ever.

In February 1770 he was rewarded for his support of Government with the place of Junior Lord of the Admiralty, which he retained for two years, and resigned on the 20th of February 1772, partly in consequence of some slight offence he had received from Lord North, and partly because he had resolved to oppose the royal marriage bill, "which, *in place*," he says, "I should be ashamed of doing;" but he had no thoughts, he adds, "of going into opposition." He had an immediate and satisfactory explanation with Lord North, but to punish him for his speech against the royal marriage act, which was a measure entirely the King's own, he was suffered to remain a considerable time out of office. At length, in January 1773, he was made one of the Lords of the Treasury, a situation he continued to fill till his memorable quarrel with Lord North in the following year.

Some gross and scandalous reflections on the Speaker of the House of Commons, written by the celebrated Horne Tooke, having appeared in the Public Advertiser, Mr Woodfall, printer of that newspaper, was called to the bar of the House, and having there confessed himself publisher of the libel, he was declared guilty of a breach of privilege; on

which Mr Herbert moved, that he should be taken into the custody of the serjeant-at-arms. The House, unwilling to engage in a fresh contest with the press and the city, were disposed to acquiesce in this motion; but Mr Fox, thinking the punishment inadequate to the offence, without consulting Lord North, moved, as an amendment, that Mr Woodfall should be committed to Newgate. Lord North found himself compelled by this motion to resist Mr Herbert's proposition, but though he substituted the Gatehouse for Newgate, as a less objectionable place of confinement, he was left in a minority on the division, the original motion being carried by a great majority. Incensed at this disgrace, and determined to punish his youthful colleague for his temerity, he had a new commission of the Treasury made out a few days afterwards, in which the name of Mr Fox was omitted. This happened in February 1774.

Long before his breach with Lord North, Mr Fox had formed an intimate acquaintance with Mr Burke, one of the leading members of the Whig or Rockingham party in the House of Commons; and to the friendship he contracted with that gentleman may, in a great measure, be attributed the decided change in his political character and opinions, which commenced at this time. He had been brought up by his father in the maxims and principles of Sir Robert Walpole; and from this education, he derived the love of peace, the good humoured spirit of conciliation, and ardent attachment to civil and religious liberty, which were afterwards the most conspicuous features of his public character, and are certainly the chief merits of the Walpole school. But the tone and character of Sir Robert Walpole's policy, though suitable, and, perhaps, necessary for the times in which he lived, was no longer adapted to the state of the country. When the Jacobites renounced their idol without changing their creed, and transferred to the House of Brunswick the same allegiance they had borne to the Stuarts, the weapons which Sir Robert had employed to preserve the constitution became, in the hands of its enemies, instruments of its destruction. Mr Burke was the first to perceive, or at least the first to explain, the change that had taken place in our internal government, and the first to point out a plan of systematic opposition in Parliament, as the only means of preventing, or at least of retarding, what Mr Hume has called the *euthanasia* of English liberty. In Mr Fox he found a pupil ready to receive his lessons, and prepared by character and turn of mind to act upon them with fortitude and perseverance. From Mr Burke's example and instructions, Mr Fox caught more elevated notions of public principle than had animated the successors of Sir Robert Walpole; and from the writings and conversation of the same great man, he learned the necessity of party connections in a mixed government like ours, to counteract the influence of government, and preserve a due balance of power between the Crown and the people. The American war roused all the energies of his mind. The discussions to which it gave rise involved all the first principles of free government. The vicissitudes of the contest tried the firmness of its opponents. Its duration exercised their perseverance. Its magnitude and the dangers of the country called forth their powers. The progress of Mr Fox was steady and uninterrupted. So early as the beginning of 1775, we are told by Gibbon, that "he discovered powers for regular debate, which neither his friends hoped, nor his enemies dreaded."

But, notwithstanding the brilliancy of his talents, and the reputation he acquired in the House of Commons, the levity and want of decorum of his private life, the dissipation in which he indulged, and the embarrassments in which he was involved, prevented him, for some years, from obtaining the weight and consideration with opposition due to his extraordinary abilities and exertions. So late as the beginning of 1778, he was under no engagements with any set of men; but, though not absolutely engaged in party connections with the Whigs, he had determined on no account to abandon their principles; and from a cool consideration of his own character, and a just conception of the prevailing sentiments of the country, he had already fully made up his mind to the fate that ultimately awaited him. "People flatter me," he says in a letter to Mr Fitzpatrick, written in 1778, "that I continue to gain rather than to lose character as an Orator; and I am so convinced this is all I ever shall gain (unless I chuse to be one of the meanest of men), that I never think of any other object of ambition.—I am certainly ambitious by nature, but I have, or think I have, totally subdued that passion. I have still as much vanity as ever, which is a happier passion by far, because great reputation, I think, I may acquire and keep; great situations I never can acquire, nor, if acquired, keep, without making sacrifices that I will never make. If I am wrong, and more sanguine people right, *tant mieux*, and I shall be as happy as they can be; but if I am right, I am sure I shall be happier for having made up my mind to my situation."—He expresses great joy at the prospect of Fitzpatrick's return, who he knew would be of his opinion in certain emergencies that might arise.—"I shall be told by prudent friends that I am under no sort of engagement to any set of men. I certainly am not; but there are many cases where there is no engagement, and yet it is dishonourable not to act as if there was one. But even suppose it were quite honourable, is it possible to be happy in acting with people of whom one has the worst opinion, and being on a cold footing (which must be the case) with all those whom one loves best, and with whom one passes one's life?" With these sentiments, it is not to be wondered at, that he rejected overtures made to him by Lord Weymouth, in summer 1778, to join administration; nor with his powerful talents and unremitted exertions, the inflexible steadiness of his public conduct, and the unexampled force and vehemence of his eloquence, that he gradually acquired the perfect confidence of the Whigs, and came at length to be considered as the leading member of the Rockingham party in the House of Commons. It ought to be recorded to the credit of Mr Burke, that he witnessed with pleasure, unmixed with envy, the progress and elevation of his pupil, and cheerfully resigned to him the station he had so long himself occupied in the party.

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The day of triumph at length arrived. A resolution against the further prosecution of the American war was carried in the House of Commons. Ministers still lingered in office, but the fears of a direct vote of censure compelled them to resign. The King, whose pertinacity in support of his favourite principles of government had been the chief, if not the sole, cause of the apparent reluctance of his Ministers to retire from office, was compelled at length to yield to the wishes of his Commons; but in the very act of forming a new administration, he contrived to sow the seeds of disunion in its bosom. The opposition to the American war had been composed of two parties, united in their disapprobation of that contest, but disagreeing on many other points of external as well as of internal policy; both calling themselves Whigs, but Whigs of different schools; the one consisting of the old Whig connection, formed and educated in the principles of Mr Burke; the other composed of the friends and followers of Lord Chatham. At the head of the first was the Marquis of Rockingham; the leader of the second was the Earl of Shelburne. His Majesty began by sounding Lord Rockingham, through the Chancellor. The demands of Lord Rockingham were, to have full power to recognize the independence of America, and authority to bring forward, as ministerial measures in Parliament, bills for reducing the influence of the Crown, by abolishing offices, excluding contractors from the House of Commons, and depriving revenue officers of their votes at elections; and, with respect to reform in the representation, or limitation of the duration of Parliament, he declined to lay himself under restrictions. After taking time to consider this answer, his Majesty sent for Lord Shelburne, and had a conference with him at Buckingham House. Two days afterwards he sent for him again, and offered him the Treasury, which his Lordship declined, saying, that no administration, suited to the present emergence, could be formed, unless Lord Rockingham was at the head of it; on which the King desired him to go to Lord Rockingham with an offer of the Treasury, and to add, that he had full powers from his Majesty to treat both with respect to men and measures, with one reservation only, that he should himself be one of the Secretaries of State. The first impulse of Lord Rockingham was to decline this offer, upon the ground, that if it was the King's intention to place him at the head of the Treasury, his Majesty could have no fit objections to conversing with him on the arrangement of the administration; but his friends persuaded him to overlook that objection, lest his refusal should be ascribed to pique or jealousy, at a moment when the public was extremely impatient for the formation of a government. Many fatal consequences ensued from the negotiation taking this course and passing through the hands of Lord Shelburne. No direct communication took place between the King and the Rockingham party, who were to compose the majority of the Cabinet, with respect to the measures to be pursued, till after the administration had been formed. Lord Thurlow, a decided partizan of the old system, and enemy to every species of reform, was retained as Lord Chancellor; Mr Dunning having been prevailed upon by his friend, Lord Shelburne, to wave his pretensions to that office. When this arrangement was communicated to Mr Fox, he told Lord Shelburne plainly, "that he perceived the administration was to consist of two parts, one belonging to the King, the other to the public." But the worst effect of all was the impression left on the mind of Lord Shelburne, that he alone possessed the confidence of his Sovereign, to the exclusion of his colleagues. This persuasion bred distractions in the Cabinet, which soon became a theatre of dissention and open division; and these divisions, whispered about, weakened the government, while it lasted, and contributed materially to its fall.

Of this short lived administration, the principal measures were the pacification of Ireland and the bills for economical and parliamentary reform, which, though short of the public expectation, are still the most important acquisitions of that description obtained since the accession of the House of Hanover. The death of Lord Rockingham dissolved the ministry over which he presided. The Treasury was immediately offered to Lord Shelburne, on pretence that, having refused it before, it naturally devolved on him on Lord Rockingham's death. His acceptance of it destroyed the former balance of parties in the Cabinet, and overset entirely the balance of power in the government. Mr Fox and Lord John Cavendish immediately resigned, and, after some interval, they were followed by Lord Keppel. The Duke of Richmond and General Conway remained in office; the latter from simplicity; the former from dissatisfaction at seeing the Duke of Portland preferred to himself as leader of the Whig party. The other members of the Cabinet were friends of Lord Shelburne.

Mr Fox has been severely blamed for his precipitancy on this occasion; and, though his resignation was a measure that could not long have been deferred, the time at which it took place makes it, perhaps, liable to that imputation. It followed so immediately the appointment of Lord Shelburne to the Treasury, as to have the appearance of being the result of disappointed personal ambition rather than of any difference on public grounds. It reduced his friends, who were in office, to the alternative of immediately following his example, or of passing for adherents of Lord Shelburne; and, as the whole of his motives could not at that time be explained in public, it gave an opportunity to the Duke of Richmond and others to keep their places without forfeiting their characters. It took place at the close of a session of Parliament, and left Lord Shelburne and the court for six months in undisturbed possession of the government. It was a cruel disappointment to the public, which had expected a firm and united administration on the principles of those who had opposed the American war and the system that gave rise to it. But to those who judged rightly the elevation of Lord Shelburne to the Treasury was the utter extinction of these hopes. The Rockingham party had found in Lord Shelburne an active and spirited ally in opposition; but they had never been confidentially united with him; and though

Fox. ready to co-operate with him in a subordinate office, they were not prepared to act under him as Premier. It was not the impatience and dissatisfaction of Mr Fox alone that broke up the administration. As soon as the appointment of Lord Shelburne to the Treasury was known in Dublin, the Duke of Portland determined to resign his office of Lord-Lieutenant of Ireland. Lord John Cavendish could with difficulty be prevailed upon to postpone his resignation for a few days. Mr Burke urged strongly to Mr Fox the impossibility of his remaining long in office as a clerk under Lord Shelburne; and, it must be owned, that, in the subsequent treatment of his colleagues, that nobleman fully justified the apprehensions then entertained of his future conduct. Elated with the fancied possession of court favour, he from that time forward treated the other ministers as mere cyphers,—made additions to his Cabinet, without consulting or even apprising them of his intentions,—and is even said to have settled and concluded the terms of his peace with France, without the advice or participation of his Secretaries of State.

There were, besides, before the death of Lord Rockingham, differences of such importance in the Cabinet as must have led to a dissolution of the administration. It was the policy of Mr Fox to detach Holland and America from their unnatural connection with France; and the great object of his foreign politics was, to form a continental alliance as a balance against the House of Bourbon. The system of Lord Shelburne was to conciliate France, to cultivate a confidential understanding with her government, and to treat her allies as so many inferior and dependent powers. Mr Fox had recommended and carried in the Cabinet (23d May 1782) a resolution to instruct Mr Grenville, his Majesty's Plenipotentiary at Paris, to propose the independence of America in the first instance, instead of making it a condition of a general treaty; and this offer, to which his Majesty's consent had been obtained, was actually communicated by Mr Grenville to Dr Franklin. Lord Shelburne, though obliged to acquiesce in the determination of the Cabinet, endeavoured afterwards to represent the offer as only conditional, to be recalled if not accepted as the price of peace; and this explanation having been adopted by a majority of the Cabinet after the illness of Lord Rockingham, Mr Fox declared his determination to resign. The discovery of a mysterious negotiation at Paris contributed to strengthen this resolution. It was a great object with Mr Fox, in pursuance of his system of policy, to open a free and unreserved communication with Dr Franklin. Through Mr Grenville he had hoped to accomplish this design, and he had nearly succeeded in his purpose, when he discovered, to his infinite surprise and indignation, that Lord Shelburne had been carrying on a clandestine intercourse with Franklin through Mr Oswald, and had received from him and made to him important communications, which had not been imparted to his colleagues. This discovery, which was made before Lord Rockingham's death, destroyed all confidence in Lord Shelburne among the friends of that nobleman, though, from the delicate nature of the transaction, it was impossible at the time to make it the subject of public animadversion or even allusion. Fox.

The resignation of Mr Fox and his friends compelled Lord Shelburne to strengthen his government from every quarter where support could be obtained. Mr Pitt, who had declined accepting a subordinate office in the Rockingham administration, became his Chancellor of the Exchequer. Rigby, Dundas, and Jenkinson, old supporters of the American war, attached themselves to his train. A negotiation was opened with the remaining partizans of Lord North, which only failed of success in consequence of Mr Pitt, with more judgment than feeling, making personal objections to Lord North himself, which wounded the pride, and excited the indignation, of his friends and family. When Parliament met after the signing of the preliminaries of peace, there were three parties, nearly of equal strength, in the House of Commons; that of the Minister, reinforced by the court, and several of the most objectionable members of Lord North's administration; the Rockingham party, who had gone into opposition with Mr Fox; and, lastly, Lord North and his friends. That three separate parties, so equally balanced, should continue to act in the House of Commons without some coalition, was not to be expected. A re-union of the Whigs would have been most acceptable to the public; but recent differences, mutual recriminations, and distrust of Lord Shelburne, rendered such a coalition impracticable. The personal objections, so harshly and acrimoniously stated against Lord North, had exasperated his friends against the ministry. Nothing, therefore, remained, but a junction of the two parties in opposition; and this coalition, which time would naturally and imperceptibly have brought about, was hastened and matured by the coincidence of their opinions against the peace. The first step was to concert an amendment to the address of thanks on the preliminary articles signed at Versailles, and this amendment was carried in the Commons by a small majority; but not without great indignation being expressed in the House, and a violent outcry raised out of doors at the apparent junction of the two parties. No coalition had yet taken place. Lord North was still at liberty to have formed an administration without Mr Fox; and it was the opinion of one of the most judicious friends of the latter, that to undertake the government with Lord North, "was to risk their credit with the public on very unsafe grounds." On the part of the Whigs, there seems to have been a momentary hesitation, whether to proceed farther, or to step back. "Unless a real good government is the consequence of this junction," says one of the most sagacious of the party, "nothing can justify it to the public."—"There never was a case of more difficulties and dangers to the real friends of Whiggism and good principles." The die was at length cast; and in an evil hour, if we are to judge, not from principles, but from results, the coalition was effected. The united strength of the two parties procured a vote of censure on the peace. Lord Shelburne, who still flattered himself with the possession of court favour, is said to have proposed an immediate dissolution of the Parliament. But he had served his turn, and

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was no longer wanted. His Majesty judged rightly, that the time was not yet come for so bold a measure, and allowed his Minister to resign.

A long interval ensued before the coalition administration was formed. Repeated attempts were made to detach Lord North from Mr Fox; and when these had failed, it was stated as an indispensable preliminary to any ministerial arrangement, that Lord Thurlow should be continued as Lord High Chancellor. But the fatal effects of a secret enemy in the Cabinet had been too severely and too recently felt, to concede a point of so much importance. A complete change of administration was insisted upon, and was granted at last, but with the worst possible grace, and with every symptom of ill humour and dissatisfaction. It was not merely the triumph of the coalition that filled the royal bosom with such indignation. His Majesty considered the Rockingham party as enemies to his just prerogative. Nor could he forgive them for their zeal against the American war, and inflexibility, when they came into office, in insisting on the unconditional acknowledgment of American independence. "The extraordinary and never to be forgotten vote of February 1782, and the hurry for negotiation that after ensued," had, in his opinion, lowered the spirit of the country, and given confidence to its enemies; and, in his own mind, had produced such indifference on political subjects, that he felt no anxiety for the arrival of the definitive treaty, or concern for the delays that retarded its conclusion. When it was suggested to him, that a wish on his part to receive a minister from America would be favourably received in that country, and might tend to preserve peace and restore harmony in future, he is said to have replied with bitterness, That to receive a minister from America, he could never say would be agreeable to him, and that he should ever have a bad opinion of any Englishman, who could accept being an accredited agent to that revolted state. With such feelings rankling in his mind, is it to be wondered at that his Majesty was hostile to an administration, the majority of which had zealously concurred in the grant of independence to America?

The coalition Ministry was hardly settled, when a misunderstanding arose about the establishment of the Prince of Wales; and so skilfully had the affair been managed on the part of the King, that if his Royal Highness had not submitted entirely to his father's pleasure, the administration must have been overturned almost as soon as formed. But, though no change was attempted before the meeting of Parliament, his Majesty contrived on every occasion to show ill humour to his Ministers, and no one, in a situation to observe, could doubt for a moment, that he only waited for a favourable opportunity to turn them out. The India bill afforded such opportunity. That measure was represented as an invasion of chartered rights,—as the establishment of a ministerial oligarchy, independent both of Prince and people. The nation, disgusted and offended at the coalition, listened with credulity and favour to these accusations. The King, who had carefully disguised his sentiments to the last moment, procured the rejection of the bill in the Lords, through the agency of Lord Temple, and instantly dismissed his Ministers.

The coalition Ministry was at an end, but its leaders still possessed the confidence of the House of Commons. The cry of secret influence was raised, and more violent addresses carried to the throne, than had ever been presented to a Prince of the House of Brunswick. Lord Temple, who had accepted the seals, grew frightened at the storm he had raised, and gave in his resignation. Even Mr Pitt became alarmed in the progress of the contest, and the firmness of the Duke of Richmond alone prevented him from following the example of his kinsman. But, as the struggle proceeded, the voice of the people was every day more unequivocally declared in support of the new administration. Courtiers and reformers,—churchmen and dissenters,—squires and nabobs,—joined in execrating the coalition and applauding the Minister, in professions of attachment to the King, and declarations of hostility to his Commons. After the attempt of the country gentlemen to make a new coalition of parties had failed, the majorities of opposition began to diminish; and when some necessary votes had been obtained, this refractory House of Commons was punished, by a premature dissolution for its want of subserviency to the Crown.

Our limits will not permit us to follow, with the same minuteness, the political life of Mr Fox in the subsequent parts of his public career. From 1784 to 1792, he was leader of a powerful party in the House of Commons, in opposition to Mr Pitt. His most remarkable exertions, during that period, were against the Westminster Scrutiny—on the Regency—against the abatement of Impeachments by a dissolution of Parliament—on the Libel Bill—and on the Russian Armament. He never published or corrected any of his speeches, except the one on moving a new writ for the borough of Tavistock; and of those published in the newspapers, and since collected, his speech on the Scrutiny is the only one so well reported, as to give the reader an adequate notion of his style of speaking. It failed, at the moment, in procuring justice for the Westminster electors; but the impression it made on the House was such, that, in the following year, an end was put to that odious and vexatious piece of chicanery, worthy of the pettifogging genius of its inventor, but disgraceful to the minister who gave it his countenance and support. We have not room to discuss at length the Regency question. The case was new and unprovided for. There was no direct precedent, nor legal authority in the kingdom to make one. Constitutional analogy pointed out the heir-apparent as the fittest person to exercise the royal authority during the indisposition of the King; and the same analogy indicated the great Council of the Realm as the body most competent to declare the incapacity and apply the proper remedy. Strict or legal right there was none on either side. The Prince had no legal right to the Regency; nor till they chose to declare it themselves, had the two Houses of Parliament any regal right to elect a Regent, or to fetter him, previous to his election, with

restrictions. The contrivance to create, first, a phantom, and then a Regent, was a clumsy piece of machinery, nearly allied to treason. The claim of right advanced for the Prince was a flimsy speculation of Lord Loughborough, adopted on his authority, without due examination, by Mr Fox, who returned in haste from Italy, while the discussions on the Regency were pending. As explained afterwards, the doctrine, if not true, was at least harmless. But the opportunity was skilfully laid hold of by the minister, for the purpose of making his rival unpopular, and of gaining time for the King's recovery, which Addington, who had great experience in such maladies, assured him, from the beginning, would certainly take place. In his argument against the abatement of Impeachment by a dissolution of Parliament, Mr Fox had the support of Mr Pitt, and never was a more triumphant reply than his answer to the present Lord Chancellor. Of the Libel Bill it is unnecessary to say a word. The country still profits by it, and regards it as a most important security to our constitutional freedom. By his exertions on the Russian Armament, he had the satisfaction to save his country from, at least, one unnecessary, unjust, and expensive war. We must hasten to an occasion where his efforts were less successful.

The beginning of the French Revolution gave universal satisfaction to the friends of liberty in this country. Soon after the taking of the Bastille, Mr Fox describes it "as the greatest, and much the best event that ever happened in the world;" and adds, "all my prepossessions against French connections for this country will be at an end, and indeed most part of my European system of politics will be altered, if this revolution has the consequence that I expect." When the King of France was brought back from Varennes, a report having been circulated in England that it was the intention of the National Assembly to bring the Queen to trial for her life, he composed a letter to Barnave, one of the leading members of the Assembly, with whom he was personally unacquainted, exhorting him against such a measure of useless cruelty, which could not fail to bring disgrace on the cause of liberty. The letter was never sent, in consequence of the report proving to be unfounded, but we subjoin some extracts from it, in order to show the spirit in which it was written. After an apology for obtruding his advice on one who was unknown to him, except by reputation, and stating the bad impression that any unnecessary severity to the Queen would produce in England;—after praising the Assembly for the firmness they had displayed on receiving the news of the King's escape, and urging them to show as much clemency and moderation in prosperity, as they had manifested coolness and resolution in danger;—after stating the argument for sending the Queen out of the country, or, at most, for confining her in a place of security, he proceeds as follows: "De l'autre coté, si on la juge cette malheureuse femme, qu'on la condamne, et qu'elle subisse son sort, je ne sais que trop bien que ce seraient les ennemis de la liberté qui en triompheront. On la peindra cette liberté comme feroce et cruelle, on tachera de la rendre odieuse, et parmi les ames faibles on ne reussira peutetre que trop bien. Le despotisme a toujours eu l'addresse de se servir des passions des hommes pour les subjuguer. Il a eu à ses gages la superstition et l'interêt personnel, et il seroit bien facheux que la pitié, la plus aimable de toutes les faiblesses humaines se rangeat aussi de son coté. Je ne sais si je me trompe, mais il me parait que vous êtes precisément dans la position ou vous pouvez faire une action belle et genereuse sans le moindre danger; c'est-à-dire, que vous etes dans la prosperité la moins equivoque. Vous avez donné par vos travaux la liberté à votre patrie, et vous trouvez dans elle une recompense aussi touchante que juste. Travaillez actuellement pour le genre humain et faites aimer la liberté à toutes les nations de la terre en prouvant qu'elle nourrit dans l'ame non seulement les vertus mâles comme le courage et la justice, mais aussi la douceur, la moderation et la clemence."—Such were the sentiments and conduct of a man, who was afterwards represented to his countrymen as the blind apologist of all the horrors of the revolution, and indifferent spectator of the calamities of the royal family of France!

As the revolution departed from its original character of justice and moderation, its favourers in this country began to fall off. Mr Burke, scandalized at the confiscation of church property, was the first of the Whig party to declare against it. His violent and outrageous quarrel with Mr Fox in the House of Commons is too well known to need to be here related. No event of his life had ever given such unfeigned sorrow to Mr Fox, as this breach with his old friend and political instructor. But he had soon many other losses of the same sort to deplore. The excesses of the revolution, the democratic form it assumed, the fear lest its example should prove contagious in England, filled with alarm the older, richer, and more Aristocratic members of the Whig party. Younger and more ardent spirits, looking to the goodness of the cause, disregarded the unfitness of the instrument used to promote it; and, exulting in the progress of political freedom abroad, thought the occasion favourable for extending and enlarging our constitutional rights at home. A schism was gradually formed in the Whig party, which the formation of the *Society of the Friends of the People*, and the royal proclamation in May 1792, brought to a public explosion. Mr Fox was eagerly courted on both sides, but if he appeared to hesitate, it was only to keep his friends, if possible, together, and prevent a permanent separation, which he foresaw would invest the minister, as it did, with absolute power. But the revolution of the 10th of August, the massacres of September, the success of the French arms under Dumourier, the violence and indiscretion of the friends of reform at home, spread a panic terror over the land; and the minister, who had trifled and temporised till it was too late, found himself unwillingly forced into a war, which he had not wisdom to avert or genius to conduct.

We cannot follow Mr Fox in his opposition to this disastrous war, nor in his subsequent efforts for the restoration of peace. On no occasion was the vigour of his intellect, the sagacity of his foresight, the

firmness and resolution of his character, more conspicuous than during the struggle he maintained against overwhelming majorities from 1792 to 1797. Till the Duke of Portland, and other alarmists of the Whig party, joined administration in 1794, he always flattered himself with the hope of renewing his connection with his old friends, when their fears should have subsided; and at every harsh or violent act of the Government, his letters express surprise, that the men with whom he had acted so long should support such measures. When finally separated from his old aristocratic connections, and convinced by fatal experience that the House of Commons had sunk into the passive instrument of ministerial power, his opinions became gradually more inclined to Parliamentary reform, from utter despair of seeing the revival of those party connections to which he had been accustomed to look for the preservation of public liberty. But, if he appealed to the constituent body against their representatves, he only followed the example which the Court and his great opponent had given in the memorable dissolution of 1784. Nothing indisposed him so much against the House of Commons as the indifference it manifested on every occasion where liberty was infringed, or injustice committed by the government. "Arguments against the war and our alliances," he observes, in a letter written in 1794, "are favourably heard in the House of Commons, though they do not get us a vote; but sentiments of liberty, and complaints of oppression, are very little attended to, however well founded. In short, liberty is not popular; and, of those who are attached to it, there are too many who have wild and impracticable schemes of government, to which the miserable state we are in, both with respect to foreign affairs and our constitution, gives more plausibility and credit than they are by their own merit entitled to. The country seems divided (very unequally I admit) between the majority, who are subdued by fears, or corrupted by hopes, and the minority, who are waiting sulkily for opportunities for violent remedies. The few who are neither subdued enough to be silent through fear, nor desperate enough to give up regular opposition, in expectation of more violent measures, are weak both in numbers and weight; but, though weak, we are right, and that must be our comfort." But, however changed the sentiments of the country, his own opinions of the value of political liberty were not altered. "I believe," says he, in another letter to the same correspondent, "the love of political liberty is *not* an error; but, if it is one, I am sure I shall never be converted from it, and I hope you never will. If it be an illusion, it is one that has brought forth more of the best qualities and exertions of the human mind than all other causes put together; and it serves to give an interest in the affairs of the world which, without it, would be insipid."—"We live," he observes on another occasion, "in times of violence and of extremes, and all those who are for creating, or even for retaining, checks upon power, are considered as enemies to order. However, one must do one's duty, and one must endeavour to do it without passion." After relating the final junction of his old friends with administration, he adds, "You will easily imagine how much I feel the separation from persons with whom I had been so long in the habit of agreeing; it seemed in some way as if I had the world to begin anew; and, if I could have done it with honour, what I should best have liked, would have been to retire from politics altogether; but this could not be done, and therefore there remains nothing but to get together what remains of our party, and begin, like Sisyphus, to roll up the stone again, which, long before it reaches the summit, may probably roll down again."

The last of these extracts shows that, notwithstanding the defection of some of the friends he most loved and esteemed, he was still convinced of the necessity of party connections, in order to maintain the cause of liberty in this country. He argues the question at length with his correspondent, and concludes by saying, "But the decisive argument upon the subject appears to me to be this: Is there any other mode or plan in this country by which a rational man can hope to stem the power and influence of the crown? I am sure that neither experience nor any well reasoned theory has ever shown any other. Is there any other plan which is likely to make so great a number of persons resist the temptations of titles and emoluments; and, if these things are so, ought we to abandon a system from which so much good has been derived, because some men have acted inconsistently; and because, from the circumstances of the moment, we are not likely to act with much effect?" It was with great reluctance, however, and with great violence to his own wishes, that he persevered in this fruitless struggle. "I am quite sick of politics," he says in August 1794, "and attend to them only because I think it a duty to do so, and that it would be unbecoming my character to quit them at such a moment." His desire to retire from public life became stronger in the following year. "I grow every day to think less of public affairs," he says in April 1795; "I wish I could be persuaded that it was right to quit public business, for I should like it to a degree that I cannot express; but I cannot yet think that it is not a duty to persevere. I am so sure that secession is the measure a shabby fellow would take in our circumstances, that I think it can scarcely be right for us. But, as far as wishes, no man ever wished any thing more. I am perfectly happy in the country. I have quite resources enough to employ my mind, and the great resource of literature I am fonder of every day. However, events and circumstances may happen, which may make that right, which I am sure would be pleasant, and I think it not unlikely but they may."

The popular spirit manifested against the treason and sedition bills, in winter 1795, revived his public zeal, but was far from giving satisfaction to his mind. "My view of things," he writes in November 1795, "is, I own, very gloomy; and I am convinced that, in a very few years, this government will become completely absolute, or that confusion will arise, of a nature almost as much to be deprecated as despotism itself. Ministers mean to bring on the first of these evils, and I cannot disguise from myself that there are but too many who wish for the second." After his success at the Westminster meeting against the bills, he says, "It is clear

we have the popularity, and I suspect we shall have it universally among the lower classes. I need not tell you how I dislike this state of things, but I cannot submit quietly to Mr Hume's *euthanasia*, which is coming on very fast." As he became more persuaded of the existence of a strong spirit of liberty among the lower classes, he became more inclined to the popular doctrines of parliamentary reform. In 1796, he expresses himself in the following manner upon that subject: "Perhaps, instead of saying *now* that the power of the House of Commons ought to be first restored, and its constitution considered afterwards, it would be better to invert the order, and to say, parliament should first be reformed, and then restored to its just influence. You will observe that I state this opinion as being mine *now*, in contradistinction to those times when the Whig party was only beaten, but not dispersed, and when I certainly *was* of a different opinion. At present I think we ought to go further towards agreeing with the democratic or popular party than at any former period, for the following reasons: *We*, as a party, I fear can do nothing, and the contest must be between the Court and the Democrats. These last, without our assistance, will either be too weak to resist the Court, and then comes Mr Hume's *euthanasia*, which you and I think the worst of all events; or, if they are strong enough, being wholly unmixed with any aristocratic leaven, and full of resentment against us for not joining them, will go, probably, to greater excesses, and bring on the only state of things which can make a man doubt whether the despotism of monarchy is not the worst of all evils."

The time at length arrived when the state of things to which he alluded in his letter of April 1795 came to pass. His remaining political friends were persuaded that it was useless to persevere longer in their parliamentary exertions, and that it was even "in some degree hurtful, as tending to deceive the country into an opinion that the House of Commons was still a place in which it was worth while to try the effect of argument and reason." When he found that no good was to be done in Parliament, that no beneficial impression was to be made on the country, and that the friends for whom he was ready to sacrifice his time and inclinations wished him to retire from public life, with doubt and hesitation in his mind as to the propriety of the measure, he gave his consent to the secession; resolving no longer to attend his duty in the House of Commons, unless particularly called upon to do so by his own constituents.

Having once retired to St Anne's, he found such enjoyment in the calmness and tranquillity of a country life, that it was with the utmost difficulty he could now and then be brought back to the House of Commons. The happiest years of his life were those he passed in retirement, from 1797 to 1802. He still took a lively interest in public concerns, and applauded and encouraged the exertions of his friends, when they returned to Parliament, but he could seldom be induced to follow their example. His time passed placidly and agreeably, in books, conversation, and the society of his family. He had always been fond of gardening, and his residence in the country gave him a turn for farming. Of the amusements of his early years, the love of shooting was the only one in which he continued to indulge, and the exercise it gave him preserved his health. His passion for literature, which had never subsided entirely, revived and became stronger than ever. Poetry and criticism were his favourite pursuits, and history his amusement. He applied with ardour to the study of the Greek tragedians, and as his proficiency increased, he found an agreeable occupation for his mind in the niceties and difficulties of that noble language. Some time after his retreat, he conceived the plan of writing a History of the Revolution of 1688. He had, many years before, expressed himself in the following manner of the work of our great historian: "I think Mr Hume's history of Charles I. the most mischievous book that ever was written. It is written with more art than any other part of his work infinitely, and is, I think, in that view a masterpiece. I do not think any answer to it or comment on it would do much good, or at least not so much as another history of the times written with his art, or even with the half of it, in the opposite view." But, though his opinion of the utility of a new history of the civil war, as an antidote to Hume, may possibly have first turned his thoughts to a work on English history, the period he selected for his own labours shows, that he had no intention to set himself up as a rival to that great historian. His sole object seems to have been, to tell the story of the Revolution, to explain how it was brought about, and to show in what its constitutional value consisted. Had he lived to complete his plan, the criticisms on Hume, in his introduction, would have formed but a small part of his book.

Mr Fox went abroad with Mrs Fox in summer 1802, partly from curiosity to see France after the extraordinary changes that had taken place in that country, and partly to collect documents for his history. As the constant friend of peace, he was received with enthusiasm wherever he went by the French people, and treated with distinguished civility and attention by their Government. He had several long conversations with the First Consul, in which the latter talked to him, with the utmost freedom, on a variety of topics,—on the Concordat then recently made,—on the Trial by Jury,—on the licentiousness of the English newspapers,—on the difference between Asiatic and European society. On one occasion, Napoleon having insinuated that Mr Windham was concerned in the assassination plots against his person, Mr Fox vindicated his old friend with warmth against so odious and unfounded an imputation. Having finished his labours at Paris, during which he collected a large mass of materials for his history, he went to La Grange, the country seat of his friend La Fayette, and, after passing some days there most agreeably, returned to England.

On his arrival in London he found great irritation in England against the Consular Government, and an absurd cry for war raised by the newspapers, and re-echoed by all who expected in any way to profit by that calamity. Ministers were apparently undecided, and, in the hopes of confirming them in a pacific disposition, he resolved for a short time to

renew his attendance in Parliament. "I shall attend on the address," he says, "because, though, if the ministry is warlike, I have no hope of dissuading them; on the other hand, if they are pacific, I may serve in some degree to encourage them." Besides his general objections to war, where it could be avoided with honour, he thought there was "in this case a moral certainty of failing in our object, and of aggrandizing France still more than we had done." Peace should be preserved, "if it could be done with honour," and he had no doubt it might, provided our Government was so disposed. If Pitt, who had not yet declared himself, should be for peace and Addington, there would be no occasion for the old Opposition taking an active part; but if he should join the war party, or "hold a conduct between peace and war," then Addington will want support, "and the support given him will be both useful and honourable." He had been told, that he should "be as much abused for pacific language now as he had been ten years before, but being in Parliament, he was determined not to blink such a question;" and, on making the trial, found "his speech in favour of peace better received by the House than any he had made since the Russian armament." The country in general, he was persuaded, was inclined to peace; and while there was "hope of contributing to prevent war, he felt himself in a manner bound" not to discontinue his attendance in the House of Commons. When the short session before Christmas closed, he still thought Ministers sincerely desirous of maintaining peace. "If I have any fears," he says on the 29th of December 1802, "it is only from a suspicion of a want of courage in Ministers to speak out what they really think, and if they should *long* continue to be afraid of speaking bold pacific language, ill humours may arise, and war begin without any wish for it in either government."

It has been invidiously said, that Mr Fox, after his return from Paris, was unwillingly dragged from his retirement by the importunity of his friends, in order to support their views in Parliament, and that his health and comfort were sacrificed to their party objects. The fact is directly the reverse. It was he, who urged them to attend, not they, who solicited him. His return to public life was his own spontaneous act, unsolicited and unexpected by his friends. His object, in the first instance, was to assist in the preservation of peace; and when the message in March 1803 had opened his eyes to the real intentions of the Ministry, his indignation at the hollowness and duplicity of their conduct made him persevere in his parliamentary attendance. From the state of parties in the House of Commons he began also to entertain hopes of the revival of a Whig Opposition, such as had existed before the fatal schism in 1792; and with his opinions of the necessity of party connections, as the only means of maintaining public liberty in this country, there was no personal sacrifice he was not willing to make for the attainment of such an end. The revival of his former connection with his old friends was the object nearest to his heart; and in Lord Grenville, though a new associate, he found, as he had formerly done in Lord North, an honourable coadjutor, with whom he could act in perfect confidence, though they had differed warmly on points that were no longer the subjects of public discussion. He was even ready to form a junction with Mr Pitt, till he discovered that Pitt, though willing to join in opposing particular measures of administration, would not break with the Court by going into regular opposition. It is a certain fact, that, of all his party, Mr Fox was the person most anxious to form a coalition with Lord Grenville; and, that whatever difficulties occurred to retard that junction, they arose not from him, but from his friends. He considered then, as he had done from the time of the American war, the influence of the Crown to be the most dangerous enemy to good government in this country; and the violence expressed for war, after the royal message, contrasted with what he conceived to have been previously the general disposition for peace, he regarded as a strong confirmation of all his apprehensions. "The King's Minister," he says in March 1803, "be he who he may, is in peace, at last, all powerful; whether or not, in case of a war, the universal apprehension of mischief from the weakness of those men could do any thing may be more of a question, but even in that case I think the Crown in earnest would beat us all." This influence, he contended, not only governed men's actions, but even swayed their opinions. "I should not be surprised," he says in January 1804, "if, in a short time, the present Minister is reckoned the ablest man in the kingdom; or, if that cannot be compassed, it will be thought and maintained, that a Minister without abilities is the best for this country." He was anxious for a junction of parties, not from motives of personal ambition, but in order to counteract this servility. "A stand should be attempted, which, though unsuccessful at present, will keep something alive against other times. To temporise is certain, absolutely certain, confirmation of the evil; no nation ever did, or ever can, recover from slavery by such methods."

The first distinct overture for a formal coalition of what were then called the New and Old Opposition, was made in January 1804, and came from the friends of Lord Grenville. It was proposed to co-operate in a systematic opposition, for the purpose of overturning Mr Addington's administration, and of substituting in its place one upon the most comprehensive basis possible. To this proposal Mr Fox was willing to have acceded at once; but owing to some repugnance on the part of his friends, it was settled, that the two parties should co-operate and concert together the measures to be brought forward in Parliament, in order to give to their debates and divisions all the strength they could, without any formal or compact engagement in case of success. The same proposition had been made to Mr Pitt, who owned that the present Ministry was weak and inadequate to the crisis, that their dismission would be a benefit to the country, and that, in case of such an event, an administration should be formed on the broadest possible basis. If his Majesty, on such an occasion, were to send for him, he should think it right to endeavour to comprehend in the arrange-

ment all parties, and even those who had been most hostile to him; but though, on many points, he would support the new opposition if it took place, he was determined never to engage with any set of men in systematic opposition. Such was the state of parties at the meeting of Parliament in February 1804. As the session advanced, Mr Pitt grew more hostile to Ministers; and, after the Easter recess, the three parties in opposition acted in concert with so much vigour, that Mr Addington thought it prudent to resign. Mr Pitt, who was sent for to form a new administration, had previously declared that he would endeavour to form one in conjunction with Lord Grenville and Mr Fox; but if he found his Majesty impracticable, he should feel himself bound to try one by himself. The result is well known. His Majesty was found to be impracticable on the subject of Mr Fox. Lord Grenville, though unfettered by engagements, refused to concur in an administration from which Mr Fox was excluded; and, by his conduct on this occasion, " satisfied those" persons of the old opposition, " who had been most prejudiced" against a junction of the two parties. Mr Pitt, abandoned by all, except his personal friends and adherents, was compelled to coalesce with the wrecks of the administration he had contributed to destroy.

After various ineffectual attempts, during the recess, to strengthen the government, Mr Pitt found himself obliged, before the meeting of Parliament, to take back Mr Addington into office. A fresh quarrel ensued; and, at the close of the session, Mr Addington (now Lord Sidmouth), and his friends, again resigned. Insinuations were then thrown out of an intention to negotiate with Opposition; but, if such overtures had been made, the new engagements contracted on the Continent, independent of other reasons, must have put a stop to the negotiation. Russia, offended at the arrogance of Napoleon, had expressed her desire to form a closer connection with Great Britain. It had been the advice of Mr Fox, that advantage should be taken of this disposition to propose reasonable terms of peace to France, under the mediation of Alexander; and, if these were refused, to conclude a defensive alliance with Russia, but on no account to provoke a fresh Continental war, which must ruin Austria, if unsuccessful. Unhappily this advice was not taken; Austria was seduced, or rather bribed, into a declaration of hostilities. The war was pre-eminently unfortunate, and all hope for a time extinguished of any balance to the power of France upon the Continent.

The death of Mr Pitt dissolved the administration he had formed. Lord Grenville was sent for by the King, and had no difficulty in persuading his Majesty to accept of the advice and services of Mr Fox. When the different parts of the new administration were to be cast, his hope and desire of peace induced Mr Fox to take the office of Secretary of State for Foreign Affairs; and, before his fatal illness, he had begun a negotiation for peace with every apparent prospect of success. The short time he was in office prevented him from realizing the sanguine expectations which his friends and the public had conceived from his past conduct and principles of government. It ought to be remembered, however, that it was to his firmness Mr Windham was indebted for the success of his limited service bill,—a measure that had to encounter every opposition which power and prejudice could raise against it; and that to his exertions, and to those of Lord Grenville, was owing a resolution of both houses of Parliament to abolish the slave trade, which Mr Pitt, in the plenitude of his power, had failed to obtain.

Mr Fox had inherited an uncommonly vigorous constitution; but, about two years before his death, he had an illness at Cheltenham, which probably laid the foundation of the malady that occasioned his death. His attendance on Lord Nelson's funeral, in January 1806, brought on a complaint to which he was ever after occasionally liable. The duties of office, and the fatigue of constant attendance on the House of Commons, did not tend to restore or confirm his health. About the middle of June he had symptoms of dropsy, both general and local, and soon afterwards his complaint had made such alarming progress as to excite the greatest fears for his life. The universal interest excited in his fate afforded the surest evidence of his great popularity. From the remotest corners of the kingdom, letters arrived daily to his family, expressing the deepest concern in his situation, and recommending remedies of all sorts for his disease. His malady, in the mean time, gained ground daily, and his physicians were at length compelled to have recourse to the common surgical operation for dropsy of the belly. The relief obtained, as usual, was but temporary. The operation was repeated, and soon after he fell into a state of languor, from which he never recovered. He expired on the 13th of September 1806, having retained his senses and understanding to the last. It has been said, that his death was accelerated by the exhibition of digitalis, administered in the vain hope of effecting a perfect cure of his disease; but the story is utterly false and unfounded, and has been publicly contradicted by his physicians. The cause of his complaint was ascertained to be a scirrhous affection of the liver.

" Mr Fox," to use the words of one who knew him well, during the last fifteen years of his life, and who has delineated his character with equal truth, force, and discrimination, * " united in a most remarkable degree, the seemingly repugnant characters of the mildest of men, and the most vehement of Orators. In private life he was gentle, modest, placable, kind, of simple manners, and so averse from dogmatism, as to be not only unostentatious, but even something inactive in conversation. His superiority was never felt but in the instruction

* *Character of Mr Fox*, by Sir James Mackintosh.—Published in Dr Parr's Collection, entitled, *Characters of Mr Fox*, by PHILOPATRIS VARVICENCIS.

Fox. which he imparted, or in the attention which his generous preference usually directed to the more obscure members of the company. The simplicity of his manners was far from excluding that perfect urbanity and amenity which flowed still more from the mildness of his nature, than from familiar intercourse with the most polished society of Europe. The pleasantry perhaps of no man of wit had so unlaboured an appearance. It seemed rather to escape from his mind, than to be produced by it. He had lived on the most intimate terms with all his contemporaries distinguished by wit, politeness, or philosophy, or learning, or the talents of public life. In the course of thirty years he had known almost every man in Europe whose intercourse could strengthen, or enrich, or polish the mind. His own literature was various and elegant. In classical erudition, which by the custom of England is more peculiarly called learning, he was inferior to few professed scholars. Like all men of genius, he delighted to take refuge in poetry, from the vulgarity and irritation of business. His own verses were easy and pleasant, and might have claimed no low place among those which the French call *vers de société*. The poetical character of his mind was displayed by his extraordinary partiality for the poetry of the two most poetical nations, or at least languages, of the west, those of the Greeks and of the Italians. He disliked political conversation, and never willingly took any part in it." *

"To speak of him justly as an Orator would require a long essay. Every where natural, he carried into public something of that simple and negligent exterior which belonged to him in private. When he began to speak, a common observer might have thought him awkward; and even a consummate judge could only have been struck with the exquisite justness of his ideas, and the transparent simplicity of his manners. But no sooner had he spoken for some time, than he was changed into another being. He forgot himself and every thing around him. He thought only of his subject. His genius warmed and kindled as he went on. He darted fire into his audience. Torrents of impetuous and irresistible eloquence swept along their feelings and conviction. He certainly possessed above all moderns that union of reason, simplicity, and vehemence, which formed the prince of orators. He was the most Demosthenean speaker since the days of Demosthenes. 'I knew him,' says Mr Burke, in a Pamphlet written after their unhappy difference, 'when he was nineteen; since which time he has risen, by slow degrees, to be the most brilliant and accomplished debater the world ever saw.'

"The quiet dignity of a mind roused only by great objects, the absence of petty bustle, the contempt of show, the abhorrence of intrigue, the plainness and downrightness, and the thorough good-nature which distinguished Mr Fox, seem to render him no unfit representative of the old English character, which, if it ever changed, we should be sanguine indeed to expect to see it succeeded by a better. The simplicity of his character inspired confidence, the ardour of his eloquence roused enthusiasm, and the gentleness of his manners invited friendship. 'I admired,' says Mr Gibbon, after describing a day passed with him at Lausanne, 'the powers of a superior man, as they are blended, in his attractive character, with all the softness and simplicity of a child: no human being was ever more free from any taint of malignity, vanity, or falsehood.'

"The measures which he supported or opposed may divide the opinion of posterity, as they have divided those of the present age. But he will most certainly command the unanimous reverence of future generations, by his pure sentiments towards the commonwealth, by his zeal for the civil and religious rights of all men, by his liberal principles favourable to mild government, to the unfettered exercise of the human faculties, and the progressive civilization of mankind; by his ardent love for a country, of which the well-being and greatness were, indeed, inseparable from his own glory; and by his profound reverence for that free constitution which he was universally admitted to understand better than any other man of his age, both in an exactly legal and in a comprehensively philosophical sense."

(D.D.D.)

* This is true of Mr Fox in the latter part of his life only. Till his separation from his old friends in 1793 his mind was too full of political subjects, not to take an eager part in political conversation even in private; and when a young man, instead of being somewhat inactive in conversation, he was very much the reverse. Dr Johnson was mistaken in supposing him habitually silent when in company, and has assigned a reason for his supposed taciturnity quite inconsistent with his real character.

FRANCE.

Situation, Extent, &c.

I. SITUATION AND EXTENT; FACE OF THE COUNTRY; CLIMATE AND SOIL.

THIS important part of continental Europe extends from the 43d to the 51st degree of N. lat. and from long. 8.25 E. to long. 4.43 W. The greatest length of France, above 600 miles, is from E. to W. viz. from Alsace to Brittany, a province which projects into the Atlantic like a wedge, and without which France would approach in form to a square. Its breadth from N. to S. is about 560 miles; its superficial extent, not yet exactly ascertained, is computed to exceed 200,000 square miles, or 128 millions of English acres.

Though in point of extent of coast and ready access from the interior to the sea, France is far inferior to Britain and Ireland, she is, on the other hand, more fortunate, in these respects, than the vast inland territories of Austria and Russia. She has the advantage of these countries likewise in strength of natural barrier, the Pyrenees forming a great bulwark on the south-west; the Alps on the south-east; the Jura and the Vosges mountains on the east. The Netherlands are the only open part of the frontier of France; the only part where the desire of extending her territory is at all confirmed or justified by the circumstances of her physical position. It is there, accordingly, that her sovereigns have been tempted to aim at foreign conquest, and where, after being repeatedly flattered by temporary triumphs, their armies have been overpowered by coalitions, and they, as well as their subjects, made to suffer dearly for the short-lived acquisition.

Surface.

The surface of France exhibits, in general, an advantageous succession of high and low ground. Less level than Poland, the north of Germany, or the greater part of European Russia, it is, on the whole, less mountainous than Spain or Italy, and may with great propriety be compared to England, with this distinction, that, while in the latter the mountainous tracts are in the north and west, in France they are in the south and east. Passing over the lofty ridges which form the frontier line of France on the side of the Pyrenees, the Alps, the Jura, the Vosges, and confining our attention to the interior, we find throughout Flanders, Picardy, Normandy, and the countries to the north and south of the Loire, a level country, diversified occasionally by hills, either insulated or in succession, but by none of the massy elevations entitled to the name of mountains. These we do not meet until reaching the south of Champagne and north of Burgundy, near the sources of the Meuse, the Moselle, the Saône, the Seine. From this bleak quarter (lat. 47 and 48) a very long range of mountains proceeds from north to south in a direction parallel to the course first of the Saône and subsequently of the Rhone, until, on approaching the Mediterranean, they branch off to the south-west and join the Pyrenees. Their greatest height is in Auvergne, about lat. 45, where this chain, or more properly a lateral branch of it, attains, at the mountains called Cantal and Puy de Dame, an elevation of fully 6000 feet, and has its highest ridge covered with snow during a great part of the year. Another, but a much less lofty range, extends from Bordeaux to the south-east, a distance of 150 miles, until it reaches the Pyrenees. The smaller chains are numerous in the east and south-east of the kingdom, viz. in Lorraine, the Nivernois, Dauphiny, Provence; also in part of the interior, particularly the Limousin and Guienne. They are interspersed with extensive plains, but, on the whole, the south and east of France are rugged and elevated tracts, and may be said to be to that country what Wales and Scotland are to Great Britain.

Rivers.

The course of the great rivers is easily connected with this view of the surface of the territory of France. The Moselle, the Meuse, the Marne, the Aube, the Seine, the Yonne, taking their rise on the northern side of the mountain chain, between lat. 47 and 48, flow all to the north or north-west, until reaching the sea, or quitting the territory of France. From the southern slope of the same range proceed the Saône, the Doubs, the Ain. These, along with many smaller streams, are all received by the Rhone, which flows almost due south, with a full and rapid current, until it reaches the Mediterranean. The Loire has by much the longest course of any river in France. It rises to the southward of lat. 45, flows in a northern direction above 200 miles; turns, near Orleans, to the west, is joined by the Cher, Indre, and Vienne from the south, and, after receiving the Sarthe from the north, falls into the Atlantic below Nantes. The Garonne, a river of less length of course, but of a great volume of water, descends from the French side of the Pyrenees, flows northward, and, after receiving from these mountains a number of tributary streams, of which the chief is the Arriège, turns to the westward near Montauban (lat. 44); it falls into the Atlantic after being augmented by the waters of the Tarn, Aveyron, Lot, and finally the Dordogne, all flowing from the western face of the mountains of Auvergne.

France has very few lakes, either in the mountainous districts of the south, or in the great levels of the north and west. It contains, however, a number of maritime inlets, forming inland bays, and communicating with the sea only by a channel of greater or less width. These occur partly on the south-west coast in Gascony; more in the south and south-east in Languedoc and Provence. Their want of depth prevents them from serving as roadsteads for shipping, and they are useful chiefly for fishing, or for the manufacture of bay-salt.

Forests.

France has much less of artificial or ornamental plantations than England, and much more of natural

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forests, the total extent of ground covered by wood being computed at seventeen millions of acres, or one-eighth of the territorial surface of the kingdom. Forests are found in almost every department. Lower Normandy contained several of considerable extent. There is a large one at Fontainebleau, only 45 miles from Paris; and a larger to the north of the Loire, in the vicinity of Orleans. Those situated in the neighbourhood of the sea, or of navigable rivers, or of great works such as glass-houses and iron-founderies, have long been subjected to an improvident consumption, so that at present the principal forests are at a great distance inland, particularly in the east of the kingdom, in the department of Ardennes, and in the long mountainous tract that forms the boundary of France on the side of Switzerland.

Scenery.

The want of ornamental plantations, and still more the almost total want of hedges, forms a great deduction from the beauty of scenery in France, and deprives the country of the cheerful aspect so striking in England. The nearest approach to the latter is seen in travelling through the fresh pastures and gentle eminences of Normandy; of the other provinces, some, like Picardy, Champagne, Poitou, consist of wide uninteresting levels; while others, such as Auvergne, part of Upper Languedoc, and the vicinity of the Alps and Pyrenees, contain a bold but bleak scenery. The most beautiful and picturesque views are to be found in the Limousin, or on the borders of the great rivers. The banks of the Loire from Orleans westward are proverbially beautiful. The Rhone, bordered by mountains, has generally a bold and occasionally a wild aspect. The Seine, equally wide, but much more tranquil, flows through verdant but less striking landscapes.

Climate.

In a country of so great extent and of such diversified surface as France, it is difficult to condense a description of the climate into a few comprehensive heads. The most natural division is into the North, South, and Central regions. The north, comprising Flanders, Picardy, Normandy, Brittany, and, in general, all that part of France, that would be bounded on the south by a diagonal line from lat. 47 on the west to lat. 49 on the east frontier, bears a great resemblance, both in temperature and produce, to the south of England. There, as with us, the predominant culture is wheat, barley, oats, rye, and such fruits as apples, pears, cherries; also hemp, flax, rapeseed. It is here, and here only in France, that the natural pastures are rich and extensive: here also the species of wood, oak, ash, elm, bear a close resemblance to ours. The central region may be said to comprise the country to the south of the Loire, or rather of the diagonal line we have mentioned, until reaching a similar line in lat. 45 on the west and 47 on the east frontier. Here, with the exception of the mountainous parts, the winter is sensibly shorter and milder. Wheat, barley, oats, and rye, are still cultivated, but maize begins to appear, and vines become general. The weather in this great inland tract is much more steady than in the north. In the summer months there is little rain, and storms, when they occur, are frequently accompanied with hail; but, on the whole, the temperature is perhaps the most pleasant in France, being exempt equally from the oppressive heat of the south and the frequent humidity of the north.

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The third region, comprehending the whole breadth of the French territory from lat. 45 and 46 to lat. 43, and in some parts to 42.30, approaches in climate to the heat of Spain and Italy; it being necessary, in the summer months, to suspend all active exercise during the middle of the day, and to reserve it for the morning and evening. A shaded situation is here the *desideratum* for a dwelling and a supply of water for agriculture. Wheat is partially cultivated; barley, oats, and rye, only on the high grounds; maize is very general, and vines supply not only the main article of export, but the usual drink of the inhabitants. The common fruits are olives and mulberries, and, in a few very warm situations, oranges and lemons. Pasturage is good only on mountainous or irrigated tracts. To pulmonic invalids the climate may be advantageous, but, in this respect, also material distinctions occur from locality, the winter in the south-east of France being at intervals very cold from the *vent de bise*, a piercing wind that blows from the Alps and the mountains of Auvergne.

Brittany, projecting into the Atlantic, is as rainy as Ireland or Cornwall. Normandy, with part of Picardy and French Flanders, may be compared to our inland counties. In the interior of France the rains are less frequent, but far more heavy; so that there is much less difference in the quantity of rain that falls in the course of the year than in the number of rainy days. The atmosphere of France is much less cloudy than ours. The most frequent wind in the north of France, as in Britain and Ireland, is the south-west; it prevails also, but to a less degree, in the central part of the kingdom. In the south of France the more common winds are from the north.

The difference of temperature between London and Paris is not considerable, nor is the degree of heat found to be intense along the west coast of France, until reaching or rather passing Poitou. In the interior it is much more perceptible, being strongly felt at Lyons, and still more in the latitude of Nismes, Aix, Marseilles, and Toulon. On the whole the variations of climate between the north and south of France are considerably greater than between the north and south of Britain, where the effect of difference of latitude is so much modified by the vicinity of the sea. We know, besides, of no such variation as the very material one indicated by the diagonal line from east to west, the latter being two degrees colder in consequence of the breezes and vapours of the Atlantic.

The harvest begins in the north of France between the 20th and 25th July: in the central part about the middle of that month: in the south in the end of June. September and October are the months of vintage. The great hazard to the corn of the central part of the kingdom arises from violent storms of rain and hail; in the south from the want of rain in spring. In winter the *vent de bise* proves often destructive to the olives. The great heats are in July, August, and September; a time of much annoyance in the south of France from gnats, flies, and

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other insects; scorpions even are found in that warm latitude.

Soil.

To exhibit a classification of the different kinds of soil is a task of difficulty in any extensive country, and in none more than in France, where a striking difference prevails not only in contiguous departments, but in contiguous districts of the same department. In Flanders, Picardy, Artois, Normandy, and the *Pays de Beance*, a fertile tract to the south of Paris, the soil consists frequently of a loamy mould; in the central and southern parts of the kingdom it is often lighter; while the greater part of Brittany, and of the departments along the western coast, have a heathy soil naturally unproductive, but capable of considerable improvement. But these collective estimates are liable to great deductions; and the attempts made by Arthur Young and other statistical writers to calculate the proportion of the different descriptions of soil, whether loam, heath, chalk, gravel, &c. are considered by the French as far from successful; even the more systematic effort made by their own government, in the beginning of this century, to compute the value of land by *masses de culture*, that is, by classing all kindred soils under one head, proved, altogether abortive. We shall forbear, therefore, all such vague calculations, and proceed to state the value of annual produce in the different departments, endeavouring to class the latter in lots, according to their position and relative productiveness.

Average annual income of the various departments of France, computed by the English acre, and in Sterling money, taking the words "annual income" in the most extensive sense, as comprising the rent of land, the farmer's profit, and the house rent of houses in towns. *

North and North-east of France.

The fertility and high state of cultivation of French Flanders, and the near approach made to it by part of Normandy and Picardy, are apparent from the following returns. The chief objects of culture there, as in England, are wheat, oats, barley, and rye; the pasturages are extensive; the horses, cattle, and sheep numerous.

	Sterling.		Sterling.
Nord (French Flanders), -	23s. 4d.	Somme, -	15s. 6d.
Seine Inférieure,	22s. 10d.	Pas de Calais,	15s. 6d.
Calvados, -	18s. 6d.	Manche, -	13s. 8d.
		Eure, -	13s. 7d.

The inland province, called formerly, from the rivers along its circumference, the Isle of France, comes next in the list of relative productiveness. The objects of culture are similar to those of Flanders and Normandy, viz. wheat, oats, and barley; but the pasturages are less rich and extensive.

Seine et Oise,	17s. 3d.	Oise, -	13s. 6d.
Seine et Marne,	13s. 7d.		

The district around Paris forms the centre of the above departments. There the average return is stated at 72s. 9d. the acre; but as this includes house rent, and is altogether a peculiar case, we proceed to the next great division of open country.

Alsace, though in some parts mountainous, is, in others level and fertile, particularly adapted to pasture and the culture of wheat.

Bas Rhin, -	14s. 3d.	Haut Rhin,	12s. 6d.

Brittany has in several parts good pasturages, and a soil adapted to the culture of wheat. Many other parts, however, consist of unproductive heaths. The general backwardness and poverty of the province are but too strikingly exemplified by the following return:

Ille et Vilaine,	8s. 10d.	Aorbihan,	6s. 8d.
Loire Inférieure,	8s. 0d.	Finisterre,	6s. 8d.
Cotes du Nord,	7s. 7d.		

Central Division of France,—Maine, Anjou, and the inland tract adjacent to the Loire.

Here also are extensive *landes*, or heath. Vines are partially cultivated, but the general produce consists of wheat, oats, barley. The pastures are extensive, though less rich than in Normandy.

Eure et Loire,	10s. 4d.	Mayenne, -	8s. 3d.
Orne, -	9s. 7d.	Loiret, -	8s. 0d.
Maine et Loire,	9s. 6d.	Indre et Loire,	7s. 2d.
Sarthe, -	9s. 5d.		

Champagne, Franche Comté, and part of Burgundy.

Of this great tract parts are level, and parts are mountainous. The climate, though in general steady, is very different in its degree of warmth, according to the elevation of the ground. Hence a considerable discrepancy in the relative fitness for pasture, for corn culture, or for vineyards. Unluckily the water communication is very limited, there being hardly any canals, and the rivers being too near their source to be navigable.

Aime, -	12s. 0d.	Aube, -	7s. 0d.
Haute Saône,	10s. 8d.	Yonne, -	7s. 0d.
Saône et Loire,	10s. 0d.	Doubs, -	7s. 0d.
Jura, -	9s. 1d.	Marne, -	6s. 10d.
Ain, -	8s. 8d.	Haute Marne,	5s. 8d.
Cote d'Or,	8s. 3d.		

The six following departments, similar to the above in latitude, and not materially different in climate, are of very inferior productiveness; in some parts, from the mountainous nature of their surface; in others, on account of extensive heaths, muirs, marshes, and tracts of sand. The objects of culture continue to be wheat, oats, and rye: vines and maize are raised in the warmest exposures.

Loire et Cher,	5s. 9d.	Allier, -	5s. 0d.
Nievre, -	5s. 8d.	Cher, -	4s. 3d.
Vienne, -	5s. 1d.	Indre, -	4s. 1d.

Lorraine is a mountainous country, containing extensive tracts of sheep pasture. Its chief agricultural products are oats and wheat.

* See Chaptal, *De l'Industrie Française*, Vol. I. p. 209.

Situation, Extent, &c.

Moselle, -	8s. 7d.	Meurthe, -	8s. 0d.
Meuse, -	7s. 6d.	Ardennes,	5s. 8d.
Vosges, -	6s. 3d.		

Auvergne.

This extensive province, and the departments to the south and south-west, are, in general, mountainous, cold, considering their latitude, and thinly peopled. The chief product of the high grounds is rye. The best departments are those of the

Loire, -	8s. 4d.	Ardêche, -	6s. 6d.
Puy de Dome,	8s. 1d.	Haute Loire,	6s. 2d.

The following, situated to the south and west of the above, are all poor and thinly peopled:

Cantal, -	5s. 2d.	Corrèze, -	4s. 3d.
Aveyron, -	4s. 10d.	Lozère, -	3s. 8d.
Haute Vienne,	14s. 4d.	Creuse, -	3s. 5d.

South-east Division of France.

Here we attain a more genial climate, and a country, in general, well adapted to the growth of the vine. But a great part of this tract (Dauphiny and Upper Languedoc) is mountainous; and the export of wine is consequently attended with much more difficulty, than along the banks of the Garonne. Wheat, maize, and silk, are the other principal products.

Rhone (including Lyons),	13s. 3d.	Bouches du Rhone,	8s. 11d.
Vaucluse,	10s. 0d.	Gard, -	8s. 10d.
Var, -	9s. 1d.	Isere, -	8s. 2d.
Herault, -	9s. 1d.	Aude, -	7s. 8d.
		Drôme, -	5s. 11d.

South-west Division.

Of the following ten departments, some are indebted for the amount of their return to the extent of their vintage; others to their productiveness in wheat or maize. In pasture or in cattle these departments are far from abundant.

Tarn et Garonne,	13s. 0d.	Haute Garonne,	10s. 2d.
Lot et Garonne,	11s. 7d.	Charente, -	8s. 11d.
Gironde (including Tarn Bordeaux),	10s. 6d.	Tarn, -	8s. 4d.
Charente Inférieure, -	10s. 2d.	Gers, -	7s. 8d.
		Dordogne, -	7s. 0d.
		Lot, -	6s. 2d.

It remains that we notice a few departments so particularly circumstanced, as not to fall under any of the preceding heads.

Vendée.

This country, so peculiar in its surface, and not likely to recover for ages the devastations of civil war, is naturally fertile. Its products are wheat, oats, and, in the warmer situations, maize.

Deux Sevres,	8s. 0d.	Vendée, -	6s. 8d.

Landes in the South-west.

Three-fourths of this department consist of sandy downs; the remainder produces maize, wheat, and vines; but the average annual produce is only 2s. 1d. *per* acre.

Pyrenees.

Here the degree of fertility becomes less and less, the more we approach to the elevated line that separates France from Spain. This rugged region contains great tracts of pasture. The corn raised is maize, wheat, oats, or barley, according to the altitude and temperature of the district.

Civil and Ecclesiastical Divisions.

Basses Pyrenées,	5s. 7d.	Arriège, -	5s. 0d.
Pyrenées Orientales, -	5s. 7d.	Hautes Pyrenées,	4s. 8d.

Lastly comes the still more lofty barrier of France to the south-east, the products of which are a little wheat in the vallies; and, in the higher grounds, pasture, with corn of the lighter species.

Hautes Alpes,	2s. 1d.	Basses Alpes,	2s. 0d.

We refer our farther remarks on this valuation to the section on Agriculture.

II. Divisions, civil and ecclesiastical.

Nothing can be more simple and uniform than the territorial divisions of France since the Revolution. Instead of old provinces or counties, disproportioned in size, and having frequently their chief town at one or other of the extremities, the departments of France have almost always the capital in the centre, and, in their extent, approximate in a great degree to equality. Each department is divided into three, four, five, or more arrondissements; each arrondissement into seven, eight, or nine cantons; and each canton into twelve, fifteen, or more communes. The *communes* in France are nearly similar to our parishes, though they are constituted *communes*, by having a civil, instead of a clerical functionary. The numbers of each class are as follows:

Departments since the peace of 1814 (including Corsica), - -	86
Arrondissements, - -	368
Cantons, - - -	2,669
Communes, - - -	38,990

A far different result this from the gigantic empire of Bonaparte, which, after his latest acquisitions in 1810, extended to Rome in the south, and to Hamburgh and Lubeck in the north, comprising above 130 departments, and a population (see our article Europe, p. 193) of forty-four millions. But of all these splendid conquests, none, with the exception of the Netherlands, formed a substantial addition to the power of France. The Italian provinces, separated by a vast natural barrier, were inhabited by a people, who bore the ascendancy of their northern neighbours, only until circumstances should enable them to throw off the yoke, and become incorporated into one great and independent state; while the Germans, still more distinct in habits and language from the French, were indignant at their humiliation, and eager to rise with the first appearance of foreign aid. Belgium alone had no natural barrier, no political attachment, to oppose to a union with France.

The ecclesiastical division of France is into bishoprics and archbishoprics. These, before the Revolution, were numerous, there being 18 archbishops and 112 bishops; but as that great political change

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bore particularly hard on the clergy, of whom, as of the *noblesse*, the great majority were adherents to the Bourbons, the number of prelates was reduced first to 85, and eventually (in 1801) to 50, viz. 9 archbishops and 41 bishops. On the restoration of the Bourbons, measures were taken to re-augment their number; and, in 1817, a new *Concordat*, concluded with the court of Rome, pronounced the creation of 9 additional archbishoprics and 33 bishoprics, carrying the totals respectively to 18 and 74. Such, however, is the division of opinion, and the habit of procrastination in political affairs in France, that the new arrangement is as yet (1820) but partially carried into effect. The 18 archbishoprics are,

Paris,	Rheims,	Auch,
Bordeaux,	Arles,	Narbonne,
Bourges,	Rouen,	Cambray,
Besançon,	Aix et Embrun,	Avignon,
Tours,	Vienne,	Lyons,
Albi,	Toulouse,	Sens.

As there are in France 86 departments, and only 76 bishoprics, a diocese necessarily comprehends a larger tract of country than a department.

A farther distribution of the French territory is into military divisions, or great districts, comprising four or five departments. Of these there are in the whole kingdom twenty-two, each having a general of rank, and a body of officers, stationed in a central town.

III. Harbours; navigable rivers; canals; roads; bridges.

Harbours.

In this important point France is considerably inferior to England, her long tract of coast, opposite to the Atlantic and the Bay of Biscay, being indifferently provided with sea-ports, and those on the southern shore of the Channel, forming a striking contrast to the spacious maritime inlets on the side of her rival. To begin from the north-east, Dunkirk has a small harbour in the interior of the town, approached on the Dutch plan by a canal leading from the sea. Boulogne has a shallow road-stead, indebted for its celebrity under Bonaparte, to the facility of giving protection by land-batteries near its entrance to a numerous assemblage of small craft. The port of Dieppe is exposed, and, of course, unsuitable for winter; that of St Malo is better, and, on doubling the projecting part of Brittany, we find, in the south-west of that province, L'Orient, a port adapted to the entrance of large merchantmen. Proceeding farther to the south, we find at La Rochelle a small, but secure harbour, and at Bordeaux, a river nearly equal in width to the Thames at London. From this there is no sea-port, until reaching Bayonne, a place of no easy access. On the Mediterranean, France has the ports of Cette and Marseilles, the latter spacious and secure.

Nantes, though a large commercial town, adjoins a shallow part of the Loire, and vessels of burden are obliged to load and unload at Paimbœuf. The great dock-yards and naval stations of the kingdom are at Brest and Toulon, both excellent harbours, and at Rochefort, which is situated on the river Charente, near its mouth. In all these the accommodation for shipping is the gift of nature; but at Cherburg the case is very different, that port containing works, of which the labour and expence (see our article Breakwater) have been very great. Its road-stead, extensive but open, has a sea-wall, which, though now in a state very different from its original destination, affords some protection from the swell of the sea; and its spacious dock, excavated since the beginning of this century, at an expence of L. 3,000,000 Sterling, is capable of containing fifty sail of the line. Havre de Grace, the best mercantile harbour in the north of France, has also been formed at a heavy expence.

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Inland Navigation.

The square form of France, favourable as it is for military defence, subjects the greater part of the country to the want of those ready and economical means of transport by sea, which form the great physical advantage of Britain and Ireland. Unluckily, this want is very imperfectly supplied by the inland waters, canals being very thinly spread, and the navigation of the great rivers subject to many obstructions; occurring in one part from rapidity, in another from shallowness; at one season from drought, at another from overflow. The application of steam to navigation promises to correct in part this most inconvenient tardiness; but the accommodation that will even then be afforded by the Loire in the interior, the Rhone in the south, the Seine in the north, and the Garonne, with its *Canal du Languedoc*, in the south-west, will be but a small portion of what is furnished by our numerous intersections in England, or of what is wanted for so extensive a territory as that of France.

The canal of Languedoc, excavated about the year 1668, was the first example in Europe of inland navigation on a great scale. Its length is about 150 miles; its general breadth 60 feet; its depth only 6 feet. As a scientific work, it did honour to an age as yet little advanced in engineering, but in a pecuniary point of view, it was unproductive, the tolls never having paid the interest of the very large sum (L. 1,200,000 Sterling) expended on it. It extends from the Mediterranean, near Agde, to the Garonne below Toulouse, and will ere long be prolonged in a northerly direction to Montauban.

The canal of Briare is of earlier date, and of much less extent; the object here was to open a navigation from the Loire on the south, to the Seine on the north, by a canal running almost due north, a distance of forty miles; it then receives from the west the canal of Orleans, proceeding also from the Loire, after which the canal is continued to the north, under the name of Canal de l'Oing, till reaching the Seine. The canal of Picardy is a work of the present age, having been begun shortly before the Revolution, and prosecuted under Bonaparte; it extends from the Oise in a northerly direction towards Lille, and is remarkable for its long tunnel near St Quentin. The *Canal du Centre* unites the Saône and the Loire in the early part of

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the course of the latter. The canal of the Ouxcq was dug, not for a commercial purpose, but to convey the water of that little river to Paris, for the consumption of the inhabitants. At a village called La Villette on the north side of Paris, there has been lately excavated, at the expence of a million Sterling, a basin, approaching in size to our London docks, and calculated, when the necessary canals shall be completed, for the deposit of merchandise brought from Havre and Rouen on the one side, and from Flanders and Champagne on the other. In the south of France, there is a short canal proceeding from the Rhone, near Tarascon, in a south-west direction to the Mediterranean, and called, from its vicinity to a well known annual fair, *Canal de Beaucaire*. These are as yet the chief canals of France. They have been made by associations of individuals as in England, or at the charge of government; but on either footing they proceed very slowly, France being very deficient both in capital and commercial enterprise; and most of the works, so loudly vaunted under the sway of Bonaparte, such as the canal of Burgundy, and the canal from the Rhine to the Rhone, being as yet in their infancy.

Roads.

The great roads in France are managed, not as with us, by county commissioners, but by government *Bureaux* or Boards, the chief of which are at Paris. The extent, under their direction, is about 30,000 miles; the annual expenditure from L. 1,300,000 to L. 1,500,000, the whole defrayed without one toll or turnpike. An attempt was made under Bonaparte to levy tolls; but this excited so much clamour in a country where commercial intercourse is carried on almost wholly by land-carriage, that it was found indispensable to seek the necessary funds from another source,—a tax on salt. The great roads in France are, in general, in tolerable condition; but no epithet can convey an idea of the wretched state of the cross roads in almost every department; full of hollows, encumbered with stones, or inundated with water, they receive hardly any repair, but are abandoned, year after year, to the effects of the elements.

The great roads in France are much wider than in England, exhibiting frequently a long straight avenue, lined on each side with chesnut trees or other large trees. They are often paved like a street for many miles in succession; the art of road-making being as yet too little understood, to prevent material injury from the heavy waggons and ill constructed wheels, without resorting to this unpleasant alternative. Travelling is thus much less agreeable than in England, particularly as the villages want neatness and cheerfulness, while most of the towns along the road are disfigured by narrow crooked streets, in which new stone buildings are often mixed with antiquated wooden structures, such as have disappeared from our provincial towns, for nearly a century back. The clumsy vehicles, formerly used for stage-coaches in France, are now replaced in most frequented roads by coaches in the English style; and the mails are now conveyed in a kind of chariot called a *malle-poste*.

Bridges.

The French have as yet but few cast-iron bridges, all their great structures of this description being of stone. Of these, the chief are the bridges over the Loire at Orleans, Tours, and Nantes; those on a smaller scale over the Seine at Paris, and those over the Saône and Rhone at Lyons. The Pont du St Esprit above Orange, over the Rhone, is a long structure of sixteen arches. At no great distance from it is the Pont du Gard, one of the most entire and beautiful monuments of Roman architecture, composed of a triple tier of arches, erected for the purpose of conducting an aqueduct over the river Gardon. This magnificent structure is 157 feet in height, 530 feet in length at the bottom, and 872 at the top. Of the lately erected bridges in France, the most remarkable are those over the Seine at Neuilly near Paris, and over the Oise at St Maixent, along with two of larger dimensions, viz. one over the Garonne at Bordeaux, the other over the Seine at Rouen.

IV. Agriculture.

Agriculture.

The agriculture of France is in a very different state from that of England or Scotland, being marked by a degree of backwardness, not a little surprising in a country so far advanced in many departments of art and science. The causes, however, are not difficult of explanation. France never enjoyed, till lately, the advantage of a representative body; and the condition of the peasantry was long far inferior to that of the same class in England. No ecclesiastical reformation had taken place, to remove a valuable part of the national territory out of the hands of indolent life-occupants; and the *grands seigneurs*, the other great body of landholders, devoted their attention to Paris and Versailles, without bestowing a thought on their lands or their tenantry, except to extract from them the means of defraying their expences in the capital. To this was added a system of taxation, less heavy indeed than that to which we are subjected in England, but extremely crude and impolitic, as evinced in the *gabelle*, or tax on salt used in private families, and in the *corvée*, or obligation on the peasantry to labour on the high roads. To these were joined the humiliating enactments of the game-laws, and the more substantial injury of tithes; for the clerical body in France levied this pernicious assessment as in England, though possessing, in property, lands of the computed rent of five millions Sterling.*

Another great drawback on French agriculture was the insignificant size of the occupancies, whether held as farms or in property. A French agriculturist, on a small scale, has little idea of selling his paternal acres, and converting the amount into a capital for a farm. He is much more likely to go on as

* See Necker's *Financial Works*.

the proprietor of eight or ten acres of land, and the cultivator of as many more. The mode of paying rent was equally singular: money-rents were general only in the north or most fertile parts of France; they did not, on the whole, exist in more than a fifth or sixth of the kingdom before the Revolution. A more frequent species of tenure was by a grant made under a reservation of a fine—of a quit rent—or of certain servitudes, of which the least burdensome were sending corn to the mill, or grapes to the press of the proprietor. But of all indications of poverty and backwardness, the most striking was the system of *metairie* described by Dr Smith; a practice, by which a tenant, having little capital of his own, receives from the proprietor the live-stock and implements necessary for cultivating his petty tenure, and divides with him its produce. This wretched method was, and still is common, not in the north or north-east of France, but in many of the poorer districts of the centre and south. There are, it is to be remarked, several distinctions in this system; the landholder, in some parts, providing only half the cattle and seed; in others, the whole. There is, of course, a corresponding difference in the apportionment of the produce.

Effects of the Revolution.

La Révolution a été faite pour le cultivateur is a common saying in France; indeed, that great convulsion improved so much the situation of the agriculturists by cancelling, at one decisive blow, the tithes, the game laws, the *corvée*, and other relics of feudal servitude, that, after all the horrors of Jacobinism, and all the tyranny of Bonaparte, the escape from former degradation still preserves an attachment to the Revolution among this pacific class. Farther, the sale of the church lands transferred a valuable mass of property from indolent into active hands. But with this we must terminate our eulogy on the Revolution, the farther progress made by agriculture, having been caused, less by any political change, than by the gradual effect of experience and diffusion of information. The degree of agricultural improvement in France since the Revolution has certainly been less than in England and Scotland, and in one very material point, that memorable convulsion has tended to retard it; we mean by that law (suggested by a jealousy of the ascendancy of the *noblesse*) which obliges the owner of property, whether in land or money, to make an almost equal division of it among his children. The parent of two children has the free disposal of only one-third of his property; the parent of three children of only one-fourth; the residue being shared equally among all. The claim of primogeniture is thus in a manner annulled; and a law, apparently wise and equitable, proves the source of great injury to agriculture, by multiplying the petty lots of land throughout a country where they were already far too numerous.

Products.

We have already mentioned, in stating the average produce of the departments, the chief objects of culture in France; it remains to exhibit a table of the apportionment of the French territory at large to different species of culture. (Chaptal, Vol. I. p. 206.)

		English Acres.
Arable ground of all kinds, poor and fertile,		56,000,000
Pasturage and meadow lands,		17,000,000
Vines, nearly		5,000,000
Kitchen gardens,		800,000
Miscellaneous culture,		2,000,000
Plantations, viz. chesnut woods,	1,000,000	
Orchards,	900,000	
Hop-grounds, osieries, nurseries,	200,000	
Olive grounds,	106,000	
Pleasure grounds and pleasure gardens,	40,000	
		2,246,000
Woods regularly cut for fuel,	16,000,000	
Woods allowed to grow for timber,	1,100,000	
		17,100,000
Heath and other lands of insignificant value,		10,000,000
Land totally unproductive in an agricultural view, viz. rocks, summits of mountains, surface of roads, sites of towns, public walks, beds of rivers, and canals,	17,000,000	
Ponds, small lakes, inland bays, marshes,	1,000,000	
		18,000,000
		128,146,000

To this we add a shorter though not less interesting table; viz. the

Comparative Culture of France and England as exhibited in proportions of 100.

	France.	England and Wales.
Land under tillage of every description, including vines,	50	34
Land in grass, whether natural or sown,	13	42
Land in forests, plantations, copses, hedges,	15	4
Poor land, as heath, marshes, commons; also land totally unproductive, as rocks, mountains, summits, beds of rivers, roads,	22	20
	100	100

This parallel, brief as it is, puts in a striking light the very different state of agriculture in the two countries. The surprising proportion of land in France under tillage is owing to the smallness of the occupancies, the cheapness of labour, and the general use of bread instead of animal food by the lower orders. The last is connected with another remarkable circumstance,—the very slender proportion of land under pasture, of which the main cause is the dry climate of the south and central part of the kingdom. In the proportion of poor and unpro-

Agriculture.

ductive land, the two countries are nearly on a par, but the French incur a very heavy disadvantage by using wood instead of coal for fuel, and covering with forests many tracts which might be made available either to pasture or tillage.

Nett Return of Land in France reckoned by the English acre, and calculated from official surveys.

	s.	d.
Tillage (average of poor and fertile soils),	11	0
Vines,	37	0
Meadow land,	37	0
Natural pasturage, chiefly mountainous,	3	6
Woods,	7	6
Chesnut plantations,	7	6
Orchards,	15	0
Kitchen gardens,	45	0
Various kinds of culture, viz. nurseries, hop-grounds, olive-grounds, &c.	18	6
General average of all France *per* English acre,	9	1

We proceed to add a few remarks on French agriculture, with reference to articles less known or less generally raised in England. Buck wheat is cultivated extensively in Normandy and the north of France, partly as green food for cattle, partly for the diet of the peasantry; it is generally sown in June and reaped in the end of September. Rapeseed is very general in French Flanders and Normandy; it supplies oil for the market and food for cattle, either when green or in the cake. Colza (cole-seed) is raised for the same purposes. Tobacco would be generally cultivated in France, did not the restrictions of the excise confine it to certain licensed parts, which are chiefly in Alsace and Picardy. Flax is raised very generally not merely in French Flanders, Alsace, and Normandy, but in the provinces of the west and south, where the family of almost every peasant rears a little stock annually to be spun by his wife and daughters. Hemp also is raised in many parts of France, particularly in the north. Maize is a plant of great importance, whether for the food of man or of cattle; when intended to stand for harvest, it is planted in rows with very little seed, and yields more than twice the quantity of wheat that would be produced on the same space. During its growth, the leaves are stripped regularly for the food of cattle; and in some districts it is sown thick and mown merely for that purpose. Such valuable substitutes have as yet prevented turnips from being generally introduced in France. Even potatoes were long very little known, and it is only during the last half century that the dislike to this root has disappeared. Chesnuts are most common in the central part of France, where they supply no inconsiderable portion of the food of the peasantry. In the south, the fruits are chiefly olives, almonds, mulberries, figs, prunes; oranges are partially cultivated in the south-east extremity of the kingdom, on the verge of Italy, but with great uncertainty, for a severe winter is fatal to these trees, and in some measure to the olives.

Irrigation is little understood in the north of France, but in the south the want of frequent rain renders it a primary object of attention; it in fact determines the *ratio* of productiveness, since the warmth of the sun seldom fails to ripen whatever, whether grass or corn, has received an adequate supply of water. It takes place in some parts by guiding the rills from the side of the hills and mountains; in others, by digging wells or raising water by a wheel; and in the vicinity of rivers by diverting a portion of their stream.

Vines.

The culture of the vine extends more or less over fully the half of France, beginning so far north as Champagne, and spreading over the country to the south and west. This culture is, however, very limited in Champagne and even in Burgundy; in Provence and the lower part of Languedoc the climate is warmer, and the culture general; though not managed with such skill as along the banks of the Garonne, where the spirit of improvement is excited by a demand for foreign markets. As vines succeed in light and unproductive soils, their culture gives a value to much ground that would otherwise be useless; and the petty subdivisions of land are here less injurious than in the case of corn. From the great variety of soil and climate, the quality of French wines is very various. The amount produced has been considerably increased since 1790, as well from the division of many large estates as from the quantity of waste land that has been brought into culture. It is computed that nearly 5,000,000 acres of land are planted with vines, and that the value of the annual produce is from L. 28,000,000 to L. 30,000,000 Sterling, of which about a tenth or twelfth part only is exported. A farther quantity, equal to about a sixth of the above, is made into brandy, for brandy is distilled wherever vines are grown; and of it also, the best qualities are in the vicinity of the Garonne.

The minuteness of the *Cadastral* survey has led to official calculations in France of products which have not yet engaged the attention of other governments. Madder is cultivated on a small scale, partly in the north, partly in the south of France; its chief use is in dyeing woollens and cottons. Wood is used for yellow and green colours; saffron, cultivated formerly to a great extent, is now confined to one district (the Gatinois) in the south of France; hops are raised only in Picardy and French Flanders.

Value of the following articles produced annually in France:

Wine,	*L.* 20,000,000
Raw silk,	600,000
Hemp,	1,200,000
Flax,	800,000
Madder,	200,000
Wood for fuel and timber of all kinds,	5,600,000
Olive-oil, rape-seed, and cole-seed,	2,800,000
Tobacco,	300,000
Chesnuts,	300,000
	40,800,000

Of the following articles, similar to the produce of our own soil, we subjoin not the value merely, but the quantity and average price:

Agriculture.

	Quantity in Winchester quarters.	Average Price. s.	d.	Annual Produce. L.
Wheat,	18,508,000	41	8	38,558,000
Rye and mixed corn (meteil),	10,886,000	27	10	15,150,000
Buck wheat,	3,022,000	14	0	2,115,000
Barley,	4,520,000	23	2	5,236,000
Peas and beans,	646,000	41	8	1,346,000
Potatoes, (56,928,000 boisseaux)		0	10½	2,491,000
Oats,	11,524,000	20	10	12,000,000
Maize and Indian corn,	2,265,000	27	10	3,152,000
Wool, Merino, 2,000,000 lbs. at 1s. 8d. *per* lb.; second quality, *metisse*, 8,000,000 lbs. at 1s. 3d.; third, or common quality, 70,000,000 lbs. 10d.				3,583,000
				83,631,000

Pasturage.

Of the pasturage ground of France, occupying one-eighth of its territory, the chief part is in Normandy, Brittany, and other humid quarters of the north and west. In the south, the natural pasture is confined to particular districts, chiefly mountainous; in the low grounds, the grass, whether natural or sown, is brought forward only by means of irrigation. Clover and sainfoin are cultivated in France, but chiefly in the north and north-east; lucerne is much more general, being raised not merely in the north, but in the central and southern provinces, wherever irrigation is practicable and the soil and climate are favourable. The art of improving cattle by breeding is little understood in France, nor is there much judgment shown in gradually fattening them by a removal to richer pastures. Still the beef and mutton of the north and west are very good, their price varies from province to province, but very seldom from year to year; the general rate is 30 *per cent.* less than in England. Butter is made and used throughout the chief part of France as in England, but cheese comparatively little. In the south, however, even butter is little known, and its place in cooking is supplied by olive oil, an unwelcome ingredient to a northern palate.

One of the latest novelties in French pasturage is the introduction, in 1819, of a large flock of Cashmere goats, which were sent to browze in the Eastern Pyrenees, and are said to experience little inconvenience from the change of climate.

Horses.

In the number of horses, as well as in their size and beauty, France is greatly inferior to our country. In the performance of labour, however, the inferiority is much less conspicuous; large, old-fashioned carriages, drawn by four or six horses, are seen proceeding along a paved road much more easily than we should anticipate from the weight of the vehicle, the knotted harness, and the diminutive size of the animals. The same observation is applicable to the ploughs, the carts, the waggons of France,—all awkwardly built, but all dragged on with expedition, —the strength of the horses surpassing the promise of their appearance;—a strength, however, attended by a circumstance of no slight inconvenience, very few of these animals being gelded. A French mail-coach performs only five instead of seven miles an hour as with us; but this is owing less to inferiority in the horses, than to the state of the roads, and to general want of dispatch at post-houses.

Of the aggregate of horses in France (about 1,500,000) more than half belong to the northern provinces, viz. Normandy, Brittany, Picardy, Alsace, and the Isle of France. In the central and southern departments, a great proportion of the work is done by oxen, which are more suitable to petty farms, and mountainous districts. The total of horned cattle in France, in 1812, was reported officially as follows:—(Chaptal, Vol. I. p. 197.)

Bulls,	214,000	Cows,	3,910,000
Oxen,	1,702,000	Heifers,	856,000

Sheep.

Sheep are reared in almost every province, the gentle elevations of the north, and the mountains of the south being alike favourable to them. The mutton is good; but, in the art of improving the fleece, the French have as yet much to learn. Merinos were first brought from Spain in 1787, and formed into a royal flock at Rambouillet. The quality, originally good, has been progressively improved, and distributions of Merinos have been successively made to proprietors of sheep pastures in all parts of the kingdom. The consequence has been, that, in many districts, the weight of the fleece has been nearly doubled. Still, in the more backward parts of France, very little attention is paid to the care of sheep, or to the improvement of the wool. The animals are not folded during night, but crowded into covered buildings (*bergeries*), and exposed, particularly in winter, to much injury from going suddenly into the air.

Mules are almost as little known in the north of France as in England. In the central and southern parts they are reared very generally. Poultry, in France, is both larger in size and more abundant than in England.

Size of Farms.

Even in the north and north-east of France, the farms are of small extent. To occupy 200 acres, or to pay a rent of L. 200 a-year, places one in the foremost rank of farmers. Larger possessions are common in pasture districts, that department of agriculture admitting, in France, as in England, of a greater concentration of capital, and extension of business than in the case of tillage. But such districts are rare, and in by far the greater part of France, the farms under tillage, if farms they can be called, are of 50, 40, 30, and often so small as 20

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or 10 acres, there being, it is computed, no less than three million of such petty occupancies in the kingdom. In the south of France, the system of *metairie* is still prevalent, nearly on the same footing as in Lombardy and Tuscany. That such insignificant occupancies are adverse to all enlarged ideas of farming, is sufficiently obvious; and to their many disadvantages there can be opposed only this single benefit—that no spot of tolerable soil is neglected, even the space given by us to hedges being reserved for culture.

General Observations.

The beneficial effect of long leases is as little understood in France as it unfortunately is in a great part of England. The common method is to let land for periods of three, six, or nine years. The peasantry, though very illiterate, are by no means a slow or phlegmatic race. They exhibit, as Frenchmen in general do, no small share of sprightliness and activity in the individual, with very little concert or combination in the mass. They are content to hand down the family occupancy from father to son, without any idea of altering their mode of life. The dwellings of the farmers, and still more of the cottagers, are, like those of our forefathers half a century ago, the outside having frequently a pool of water in its vicinity, while the inside is miserably bare of furniture. Their implements are equally rude, and discover but too clearly that the price of iron is beyond their reach. Their harrows have wooden teeth; and even the ploughs, in some backward districts, are almost entirely of wood. The cart in common use is an awkward medium between a cart and a waggon, being as long as the latter, and not broader than the former. The singularity, to an Englishman, is to see a vehicle of great length and burden supported by a single pair of wheels. Corn and hay, in France, are not stocked, but housed. The winnowing machine is, in a measure, unknown; the threshing machine altogether. Threshing often takes place in the open air, and is, in general, performed by the flail. In the south of France, the antiquitated mode of treading out the corn by horses and mules is still prevalent.

The diet of the French peasantry is very simple: Bread and cyder, with soup, pease, cabbage, or other vegetables, form its chief ingredients in the northern provinces, while, in the central and southern, the same aliments are in use, with the substitution of thin wine (*vin de pays*) for cyder, and of chesnuts for the pears and apples of the north. Bread is, still more than with our peasantry, the grand component part of diet, and the article of which the price determines the comfort or distress of the lower orders for the year. Butcher meat is reserved for the tables of the middling and upper classes.

The landholders in France give almost no attention whatever to beautifying the country; its aspect is consequently monotonous, without plantations, seats, or cheerful cottages. The peasantry live in villages, frequently ill built and ill situated. The purchase of land, however, is the favourite mode of investing money in France. It sells, in general, for 25 years purchase, while the public funds seldom fetch above 16 or 18. The French have little confidence in government stock; and, in fact, very little knowledge of its nature. There is at Paris a society similar to the *Board of Agriculture* in England, and forming, like it, a central point for corresponding with the different agricultural societies in the kingdom. It holds a sitting twice a month, and a public meeting annually, for the distribution of prizes. The French have also (since 1819) a corn law, permitting imports and exports only when the home market shall be above or below a specific rate. This law, somewhat similar to ours in form, is materially different in its operation, the limitation prices being very low, and the landed interest, in France, having no power to create an artificial enhancement. The Revolution, by breaking landed property into fragments, has destroyed the ascendancy of its owners as a separate interest. The members of the French House of Commons are, in general, lawyers, merchants, or *proprietaires*, that is, owners of land and houses on a scale which we should account very small. Even in their House of Peers, the country interest is of little account. The chief difficulty the French government have to contend with, in regard to the corn trade, is the popular prejudice that freedom of export raises the home price. The south of France being in a great degree appropriated to the culture of the vine and olive, stands in need of an almost annual import of corn. The north is very different; yet the smallness of the farms, the use of bread in every meal of the day, and the want of agricultural capital, are great drawbacks on export. In the present century, the only shipments of consequence have taken place in 1810 and 1814, both years of unusual abundance.

Woods and Forests.

Of the 17,000,000 of acres which we have mentioned as covered with wood in France, the proportion belonging to government is about 3,700,000 acres. A very small part of this is allowed to grow for large timber. The rest is subject to an annual cutting and sale, for fuel, a purpose for which coal is very little used in France, except in the case of forges, glass-houses, and other large works. In the government forests, gross mismanagement took place during the disorders of the Revolution. Extensive tracts were sold for an insignificant consideration, while, in those that remained, timber was felled with a lavish hand, and without any regard to the ultimate effect on these valuable properties. The case, however, was altered in 1801, when a special board, appointed for the care of the forests, introduced the most satisfactory regulations. In the years of financial pressure (1815, 1816, and 1817), it was proposed to effect sales of these great domains: but a fair price being unattainable, government continues to keep them, and derives, from the wood annually cut and sold, a revenue of from L.700,000 to L.800,000 Sterling. Fuel being little wanted in the south of France, the forests are confined to remote and rugged situations. These, like most of the forests of the kingdom, harbour a multitude of wolves, which are frequently destructive to the sheep and lambs. Regular officers, called *Lieutenants de Louveterie*, are appointed for wooded districts; and, on occasions of heavy loss, recourse is had to a general

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battue, of which the usual result is a partial destruction of these animals, without any sensible reduction of their numbers at large. Bears, also, are found in the forests, but they are much more rare, being confined to the high lying districts in the Alps and Pyrenees.

After these observations on the agriculture of France, it remains to compare its produce with that of our own country—an inquiry that naturally divides into two parts—the total, or, as it is termed, the gross amount produced, and the nett income afforded after all deductions for expence of culture. First, as to the gross produce, Dr Colquhoun estimates the property created in Great Britain and Ireland, in the year 1812, by agriculture, in all its branches, at

nearly - - -	L.217,000,000
Add for seed corn, not included in this estimate. Also for the increase of our population, and corresponding increase of our produce from 1812 to 1820, -	33,000,000
	L.250,000,000
Deduct for decrease in prices by the change from war to peace, 25 *per cent.* - -	62,500,000
Remains,	L.187,500,000
The amount of property annually created by agriculture in France is computed, by M. Chaptal at	L.190,000,000
This calculation was made in peace, and at prices (see the preceding corn table) so low that, to bring them to an equality with our own, even in peace, we must make an addition of - -	80,000,000
Together,	L.270,000,000

Those readers who imagine that the addition for the difference in the value of money is too large, have merely to refer to the quantities of produce in the preceding corn table, or to the surer test afforded by the relative population of the two countries. Supposing that our population is now increased to 19 millions, that of France still exceeds it by fully 10 millions, a number which, were the consumption of the individual the same, would imply, on the part of France, an annual production of the value of above L.280,000,000. If to this a small addition be made for the French produce exported, our estimate will be found to make the requisite allowance for the plainer fare of Frenchmen, and a small allowance will be deemed sufficient when we take into account the very cheap diet of the Irish part of our population. But the point to be explained is not how France produces so much, but how she does not produce more. Britain and Ireland are to her, in territorial extent, in the proportion of 61 to 100, but in produce they are as 69 to 100. As the soil of France, if not superior, on an average, to that of England and Ireland, is greatly superior to that of Scotland or Wales, to what are we to look for the inferiority of her produce? There are, we apprehend, two main causes—first, the waste of large tracts in wood, and next, the inadequacy of manual labour, largely as it is afforded by her dense agricultural population, to counterbalance the productive powers of the capital and machinery applied by us to agriculture.

We come next to the question of the clear income arising from land, the amount of which was seldom above a fourth part of the gross produce, since it implies a number of very heavy deductions, viz. the support of the farmers, their families, their servants, their cattle; the mortality and depreciation of live stock; wages, wear of tools and implements; in short, of every description of charge that intervenes between preparing the ground for culture, and realizing its produce in money. In regard to France, we are enabled to proceed in such computations with considerable accuracy, in consequence of several late estimates made by order of government, of which the highest, and we believe the most accurate, made in 1815, gives, for the clear return of the

land, about - -	L.52,000,000
To which adding, to bring the low prices in the valuation to a par with our own, - -	23,000,000
Total,	L.75,000,000

a sum, including not rent merely, but rent and farmer's profit together. In England, our best authority for this purpose is the return made under the property-tax act, in 1810, a time when our paper currency was but slightly depreciated. This return gave, for England and Wales, for rent solely,

about - -	L.29,000,000
Add for Scotland and Ireland, a computed amount of -	11,000,000
Deduct for decrease of rent, increase of poor-rate, and other burdens since 1810, - -	40,000,000
25 *per cent.* -	10,000,000
leaving, after payment of tithe and poor-rate, - -	30,000,000
The collective income of the farmers of England and Wales, in 1810, was, like the rent, about L.29,000,000, to which, making a similar addition for Scotland and Ireland, and a similar deduction for the fall of prices, and increase of burdens, the result is a farther sum of - - -	30,000,000
In all,	L.60,000,000

In these returns of nett income the balance is considerably more in our favour than in those of gross produce. In the one Britain and Ireland are to France as 69 to 100; in the other as 80 to 100. To what is this extraordinary disadvantage on the side of France to be attributed? We answer, to the employing

of manual labour instead of machinery, and to the very great addition thus caused to the number of persons to be supported out of the produce of the land before realizing its proceeds. In England and Scotland the agriculturists are not to the population at large as 40 to 100; and, after making a large addition for Ireland, which bears, in its petty occupancies, no slight resemblance to France, the result does not give, for our whole population, 44 persons in 100 dependent for support on agriculture. But in France, this proportion exceeds 60 in 100; and there are thus to be supported out of agricultural produce above 5,000,000 persons more than there would be, were the proportion of agriculturists as in Britain and Ireland.

	s.	*d.*
The average income of the whole kingdom, *per* English acre, is, we have already said,	9	1
But as this includes the rent of houses in towns, there is to be deducted, on that account, a sixth, or - -	1	6
Leaving - -	7	7
To which, adding one-half for the very low prices in the French estimate, -	3	9
The result is -	11	4

per acre, valuing the produce according to the currency of English markets. This comprises both landlord's rent and farmer's profit. There are at present no satisfactory means of computing either separately; but, if we suppose them equal, the rental

of France is only - -	L. 26,000,000
From which, by a single tax, the *Foncier*, a deduction is made of above	5,000,000
Leaving -	L. 21,000,000
Equal in England, after making allowance for the difference of money, to	L. 30,000,000

In other words, the rental of Britain and Ireland, after allowing for the difference of money, and after deducting tithe, poor-rate, and taxes of every kind, is equal to that of all France,—a proof, if any were wanting, how much more our landholders are favoured by the Legislature than those of the same class on the south side of the Channel.

V. Mines and quarries.

Of gold there are hardly any mines in France. Of silver there are several in the mountainous districts. A far more important metallic treasure is the iron ore found in a number of the mountainous departments; in the east, in Lorraine and Champagne; in the interior, in Auvergne and Languedoc; and in the south-west, in the Pyrenees. Of copper also there are mines, not deficient either in quality or quantity; but it is, above all, in regard to these that France experiences the want of canals, to convey from one mine to another either the ore or the coal, which, by some of their writers, is aptly termed *cette force vive en lingots*. To smelt one ton of copper requires two, or two and a half tons of coal,—a rapidity of consumption which no forest can long supply. Coal has been discovered in more than half the departments of the kingdom, and will, doubtless, be traced in others; but the want of water communication limits its consumption so much, that the whole value of coal annually extracted from the mines in France is not above L. 2,000,000 Sterling; nor is the quality in general so good as in England. At St Etienne, near Lyons, are excellent coal mines; but there being no iron mines in the vicinity, there are no iron works, and no consumption of fuel on a large scale: the coal is of use only for domestic fuel, and for the manufacture of hardware. Altogether, there are in France 500 metallic mines, great and small; the number of workmen employed on them is about 18,000. The mines, like other large undertakings in France, are under the direction of government; being superintended by a board at Paris (*Conseil Général*), and having an *Ecole Royale* with public teachers, the whole under the control of the minister of the home department. This, however, does not prevent their machinery being in general very clumsy and antiquated.

Turf fit for fuel, as in Ireland, is found in various parts of France, and is likely to be used, as wood becomes progressively scarcer.

Salt

Salt is made in various parts of the kingdom. The works corresponding to the salt mines, or rather to the brine springs of Cheshire, are called, from their position, *Salines de l'Est*, and are situated at the small town of Salins in Franche Comté; they are wrought by undertakers on lease, yield about 20,000 tons a-year, and afford a considerable revenue to government. The heat of the climate on the south and south-west coast of France is favourable to the evaporation of salt water, and consequently to the formation of bay salt; the name given to salt made, not by the action of fire, but by the heat of the sun, operating on sea water, inclosed in a shallow bay (in French *etang*), so as to produce a saline deposit. The duty raised from salt in France is in all nearly L. 2,000,000, a sum of great importance to the Treasury, but attended with fully as much injury to the productive powers of France, as our salt-tax to those of England. The Revolution began by abolishing entirely the odious *Gabelle*, and salt being soon after made in great quantities, and sold very cheap, became the object of a most extensive consumption, being given to cattle as food, mixed with manure on the fields, or scattered as a stimulant to vegetation at the foot of olive trees. But this extended use of salt was of short duration. No sooner was the power of Bonaparte consolidated, than he ventured to impose a tax on salt, less impolitic and oppressive indeed than the *gabelle*, but which had the effect of limiting the use of this article to such a degree, that the consumption of bay salt, instead of amounting to L. 1,000,000 Sterling, does not at present exceed L. 100,000. The consumption is confined to domestic purposes, and to a trifling export; yet the few cattle that still receive

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salt as a part of their food are visibly in better condition than those that are deprived of it.

Quarries.

France is in general much better supplied with quarries than England. The vicinity of Paris abounds in quarries of freestone. The case is similar in the mountainous districts, and even in several, such as Lower Normandy, that are comparatively level. The houses are consequently built of stone in those cities, which, like Paris or Caen, are in the vicinity of quarries. In other situations they exhibit a mixture of stone and brick. Slates being comparatively rare, the roofs of the houses are generally of tile, and the annual value of this rude species of productive labour,—the manufacture of bricks and tiles, may be computed at nearly L. 1,000,000 Sterling. There are marble quarries in several of the mountainous districts; but not situated so as to admit of export.

VI. Manufactures.

Our historical notices of French manufactures are very imperfect, until towards the year 1600, when the wars of religion were brought to a close, and peaceful industry received encouragement from Henry IV. and his minister Sully. It was then that the patronage of government was extended to the manufacture of silk, of glass, of jewellery, of gold and silver tissues; also of the finer woollens and linens; for the coarser kinds had been established many centuries before. But the great extension of the finer manufactures of France took place after 1668, during the reign of Louis XIV., and the ministry of Colbert. It was then that workmen were invited from Holland, and induced to settle at Sedan and Abbeville, places still celebrated for their woollens. In the south of France also, establishments were formed for making the light cloth suited to the Turkey market, so that, towards the year 1700, the manufactures of France, as well for woollens as other articles, had made considerable progress; we mean, that they had arrived at the state to be expected from a people of great activity, but of little combination. The manual labour of the workmen was ingenious; the machinery extremely imperfect; the linen, the paper, and, in some measure, the woollens and hardware, found their way abroad, because in the rest of Europe these manufactures were very backward; and, in particular, because the exports of England were then very limited. The repeal of the edict of Nantes was a very impolitic measure, but its consequences have been much overrated, for England has profited very little by the extension of her silk fabrics; and Brandenburg, the chief resort of the French emigrants, has never become an exporting manufacturing country.

Another and a more important error is the current notion that French manufactures were formerly (from 1650 to 1750) more extensive and flourishing than at present: also that they underwent an almost total extinction during the Revolution. These, like many other impressions, in regard to France, rest merely on the loose allegations common in that country, where current report almost always partakes of the marvellous. Official *data*, wherever they are preserved, far from sanctioning such fluctuations, are in favour of a progressive, though slow increase.

Woollen Manufacture.

To begin with the oldest, and most widely diffused branch, woollens, we find * that the relative numbers of workmen, at three distinct intervals, and in very different parts of the country, were as follows:

	1789.	1800.	1812.
viz. Eastern Pyrenees, Carcassone, - - -		8,000	9,000
Do. Limoux, - - -	4,400	4,500	6,200
In Languedoc, St Afrique, and Rhodez, - -	6,700	8,500	10,000
Do. Castres, Albi and Mazamet, -	10,400	13,600	18,300
North of France, Vire, - - -	3,000	3,800	4,800

Lizieux also in the north had nearly the same number of workmen (5000) throughout.

The finest qualities of woollens are made at Sedan, in Champagne, and at Louviers, in Normandy. In these the only material is Merino wool. At Elboeuf and Darnetal, both likewise in Normandy, the qualities are very various, the prices being from 6s. to 28s. the English yard. Carcassonne and Limoux owed the origin of their extensive manufactures to the abundant supply of wool from the pastures in the Pyrenees. Since the reduction of their exports to the Levant, an alteration in the quality of their cloths has opened to them a vent in the interior of France. The mountainous districts in Languedoc contain great numbers of sheep, and are the seat of the manufacture of serges, tricots, and other coarse woollens, most of which are made, not by workmen collected in a factory, but on the domestic plan still followed in part of Yorkshire, and in the north-west of Wales. In the hamlets or villages of the departments of the Tarn and Aveyron, almost every house has its loom, and during the evenings in winter, or in the day time, when the weather is adverse to country labour, the women employ themselves in spinning, and the men in weaving.

A highly-finished species of the woollen manufacture, viz. shawls, veils, ladies' cloth, &c. has been introduced in the present age into France. Rheims is the seat of this important branch, and employs, in the town and neighbourhood, no less than 20,000 workmen. Similar articles are made at Paris. Two towns very remote from each other, Lodève in the south, and Vire in the north-west of France, manufactured, under Bonaparte, very largely for the army. French woollens are, in general, much thicker than ours. In the fine qualities, the raw material forms (Chaptal, Vol. II. p. 131) somewhat more than half the cost. In ordinary qualities, it is somewhat

* Costaz *sur l'Agriculture et les Manufactures de la France*, p. 108.

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less; but it is only in the slight qualities that the price of labour goes considerably beyond that of the materials. The computation for the whole country is, that a value of L.4,000,000 Sterling in wool, becomes converted into a manufactured value of L.9,000,000, of which a tenth only is exported; for, though French woollens in general are more substantial and durable than English, the inability of their merchants to give long credit prevents their competing with us in the United States, or other foreign markets. The cloth, in France, which corresponds to our superfine, and which is worn, in general, by the upper ranks, is very fine and durable, but heavy. In price, it varies from 22s. to 35s. the English yard.

Cotton.

The cotton manufacture was introduced into France about 1770, and at first in the south of the kingdom, the raw material being supplied, not from America, but from the Levant. From the south, this manufacture passed, about 1780, to Rouen, St Quentin, Paris, Lille, and other parts in the north, extending with a rapidity surpassed only by that of England. At present, and for many years back, the great import of cotton is from the United States. The total of the raw material annually brought into France is calculated (Chaptal, Vol. II. p. 150) at an average of L.3,500,000, and the value of the finished articles, after adding the labour and profit in every stage, at nearly L.8,000,000. This is not above one-fourth of the amount of the cottons annually made in Britain; for, in this great department of manufacture, the French have only followed our steps, adopting our machinery after a certain lapse of time, and equalling us, perhaps, in the durability of the fabric, but seldom in its elegance or cheapness. The last is, in a great measure, owing to the centre of the manufacture being at Rouen and Paris, places where the support of workmen, including the extra price of fuel, is not less expensive than in Lancashire. The districts at present most remarkable for the cotton manufacture are,

	Looms in 1812.	Workmen in 1812.
Normandy, Rouen, and adjacent towns, - -	10,800	40,000
Lyons and Tarrare,	8,000	23,000
French Flanders, Lille, Cambray, - -	10,100	20,000
Paris, and its districts, not ascertained.		7,000
Picardy, St Quentin, and adjacent towns, -	10,700	14,600
——— Abbeville, Amiens, and their vicinity, -	5,600	14,000
Champagne, Troyes, and adjacent towns, -	7,000	13,700
Alsace, Mulhausen, Bischweiler, &c. - -		19,000

Cotton yarn is often made in a different place from cotton cloth. Paris and French Flanders are the chief quarters for the supply of the former article, which is sent in quantities to Rouen, St Quentin, and other places. In former years, cotton yarn used to be smuggled in great quantities from England, but this is now limited to the finer qualities. The cotton manufactures of the more substantial kind, called *Bonneterie*, such as stockings and caps, are carried on in Champagne, in Normandy, and in the department of the Gard, in Languedoc. The total of the workmen, young and old, employed on cotton in France, appears to be about 200,000

The number of works for spinning cotton yarn nearly - - -	300
Looms for making *Bonneterie* (in 1812) above - - -	10,000
Looms for weaving cotton cloth, -	70,000

Linen.

In the extent of her linen manufacture, France is greatly superior to England; not that her soil is better adapted to the growth of hemp and flax, but because England depends on importations of linen from Ireland and Germany; and the spinning of flax does not form the occupation of our female peasantry. In France, particularly in the north, every farmer, and almost every cottager, covers a little spot with hemp or flax sufficient to employ his wife and daughters in spinning throughout the year; a stock of linen being the usual dowry of these humble occupants of the soil. The weavers reside in towns and villages. In Normandy, Lisieux, Dieppe, the neighbourhood of Havre, Yvetst, Bolbec, and the more inland towns of Vimoirtiers and Domfront, are all remarkable for one or more branches of the linen manufacture. The more backward province of Brittany manufactures, at Rennes, St Malo, and Vitré, quantities of coarse linen, canvas, and sacking; but Anjou affords a much superior article; *the toiles de Laval* have long been in repute, and give employment, in Laval and the contiguous towns, to nearly 25,000 workmen. Lille and its populous district have very extensive manufactures of hemp and flax, for the number of workmen so employed, directly or indirectly, in this part of French Flanders, is not short of 50,000. Since 1790, fine linen has, in France as in England, been in a great measure replaced by fine cotton: the two together employ, at St Quentin (in Picardy) and the neighbourhood, no less than 40,000 workmen. In a very different part of the kingdom, the province of Dauphiné, there are carried on linen manufactures of various qualities, the prices being from 1s. 6d. to 5s. a yard.

Cambrics, thread, gauze, lawn, rank among the leading manufactures of the north-east part of France. They are made at St Quentin, Valenciennes, Cambray, and in a smaller degree at Douay, Chauney, and Guise. Lace is still more general, being made in quantities at Valenciennes, Dieppe, Alençon, Caen, Bayeux, Argentan. Machinery has as yet (1820) been very little applied to this manufacture in France, and the number of women employed by it is very great.

The hemp annually grown in France may be computed, as a raw material, at L.1,200,000, the quantity imported at L.200,000; together, L.1,400,000, a value which is doubled in the coarse, and tripled in the finer manufactures. Of this quantity of hemp the half is made into canvas and thread, a third into cordage, and the remainder into cloth for domestic use. Of the flax annually used, the value, as a raw

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material, is about L.800,000; a sum which is tripled when made up into thread, linen, and mixed stuffs, and much more than tripled in the finer qualities. On the whole, the value of the finished fabric from hemp is supposed (Chaptal, Vol. II. p. 142) to be

about - - -	L.4,500,000
That from flax, including lace, -	3,000,000
Add for the domestic manufacture of the peasantry, - -	2,500,000
Total value made in France, from the stoutest sail cloth to the finest lace, - -	L.10,000,000

French linen differs in quality according to the place of manufacture; but, in general, it is thicker and stiffer than Irish linen, while, in whiteness, it is inferior to the linen of Flanders and Holland. It is, however, a substantial and durable article.

Hardware.

France has at present (1820) 330 blast furnaces, the position of which is regulated by that of the iron mines. They are chiefly in the mountainous departments of the Dordogne in the south-west, and of the Haute Marne, the Haute Saone, and the *Cote d'Or*, in the east of the kingdom. Of forges for malleable iron, called *forges à la Catalane*, there are eighty-six scattered throughout different departments, but chiefly in the hilly part of Languedoc. There are also a number of wire works in France, in which, as in the blast furnaces, there has been, since 1790, a progressive but very slow increase, altogether different from the rapid advance of the iron-works of England previous to 1815. The stationary character of these works has evidently been owing to the deficiency of fuel and of water communication; disadvantages which prevent the hardware manufactures from being concentrated in cities or populous districts, and cause them to be spread over the country in petty towns or villages, with a very limited division of labour, and a consequent inferiority of execution. The result is, that France does not export hardware, and that in nothing is the inferiority of domestic accommodation in that country more conspicuous than in articles which belong to the province of the locksmith and cutler. The amount of pig iron annually made in France appears (Chaptal, Vol. II. p. 154) to be about 100,000 tons. The value of the hardware of the kingdom, inclusive of cutlery, arms, and other articles of nice workmanship, is computed at L. 8,000,000 or L. 9,000,000 Sterling. The annual import of iron and steel is only from L. 2,000,000 to L. 3,000,000. In copper, the case is different, the importations greatly exceeding the home produce. Of lead, also, the chief part is imported.

Silk.

In this department France possesses, both from physical causes and from long established manufacture, a decided superiority. Mulberry trees were introduced in the fifteenth century, and were first planted, not in the south, but in the central part of the kingdom, near Tours. That town was the seat of the earliest silk manufactures, and it was not till 1600 that the culture of the mulberry was carried southward. It is now prosecuted in twelve departments, which, in 1812, produced as follows (Chaptal, Vol. I. p. 181):

	Silk in Cocoons. *lbs.*		Silk in Cocoons. *lbs.*
Indre et Loire,	35,500	Brought over,	6,175,800
Allier, .	6,300	Vaucluse,	2,200,000
Ain, .	12,500	Gard, .	1,710,000
Loire, .	35,500	Herault,	486,000
Isere, .	1,847,000	Mouths of the Rhone,	873,000
Ardeche,	2,737,000	Var, .	210,000
Drome,	1,502,000		
	6,175,800		11,654,800

The mulberry thrives in a variety of soils, and may be planted with success in neglected borders or in waste lands; the labours of the silk-worm last only six weeks, after which the cocoons are in a state to be purchased for winding or carding. These processes reduce the quantity so much, that the produce of an average year does not exceed 560,000 lbs. *soie grèze*, worth 20s. or 21s. the lb.; and 322,000 lbs. organzined silk, at 25s.

To this is to be added an equal quantity of foreign silk imported, chiefly from Italy. The cost of manufacture nearly doubles the value of the raw material in the plainer qualities, and in the highly finished, such as fine ribbons, may be said to triple it.

State of the Silk Manufacture in 1812.

	Looms.	Workmen.
Tours, . .	320	960
Gange (in Languedoc), (stocking looms), . .	922	1000
Avignon, . .	1600	5000
Nimes, . .	4900	13,700
St Chammond and St Etienne, to the west of Lyons; ribbons chiefly, . .	8200	15,450
Lyons, . .	10,700	15,500

Paris also contains extensive silk manufactures. As the persons indirectly supported by such a branch greatly exceed the number of weavers, it is no exaggeration to compute at 60,000 or 70,000 the individuals, young and old, supported in Lyons and its district, by the silk trade in all its different stages. This important manufacture has undergone considerable fluctuations, having suffered a diminution, previous to 1790, from the general introduction of cottons, and having felt severely the calamities of the Revolution, which necessarily reduced the consumption of an article of luxury. At present the amount of the silk manufacture of France is nearly L. 5,000,000, a sum equal indeed to its amount in 1790, but which shows that this manufacture has not kept pace with the increase of wealth and population,—a consequence, doubtless, of the cheapness and beauty of the cotton fabrics. The export of French silks is about a third of the quantity made.

Leather.

Leather in France is not taxed as with us, and the effects of the exemption are apparent in the price of the articles of which it is the chief material; all of

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which are cheaper by a third than in England. The value of leather annually prepared for sale in France is (Chaptal, Vol. II. p. 187) nearly L. 3,000,000 Sterling; when made up into articles as boots, shoes, saddles, harness, its value is nearly double.

Jewellery, Porcelain, &c.

Jewellery, as well as watch and clock making, are carried to a considerable extent in France, particularly at Paris; a time-piece is there a much more frequent article of ornamental furniture than in England, and the number of new watches made annually in the kingdom, is not less than 300,000; altogether, the value of these different kinds of workmanship amounts to L. 1,500,000 of which more than the half is made in the capital. The works in bronze, belong still more particularly to the capital, and form, in their different branches and stages, of which gilding is the chief, a farther annual value of L. 1,500,000 Sterling.

Paris is remarkable for other fabrics of taste and luxury; in particular, the porcelain of Sèvres near St Cloud, and the beautiful but very expensive tapestry of the Gobelins. The materials of the latter are silk and the finest woollen thread; the subjects woven into the work are taken from paintings executed on purpose. Both the establishments have been long conducted by government at a sacrifice, and both are now on a reduced scale, the articles being far too costly for private individuals. The latter are more frequently purchasers of *passementerie*, by which is understood artificial flowers, fringes, gold and silver lace, with a variety of trifling but tasteful articles, all sufficiently adapted to a city where so much more is thought of display than of utility.

Soap.

The value of all the soap made in France is computed at L. 1,400,000. The main ingredient is olive oil, and Marseilles was formerly the seat of this manufacture for almost all France; an advantage owing both to the extent of the olive-grounds in the south-east of the kingdom, and the vicinity of Marseilles to Italy, the Levant, and Spain, whence soda and olive oil were imported in vast quantities. The disorders of the Revolution, and the establishment of similar manufactures in other parts of France, have caused to Marseilles the loss of a third of its soap works; they are still, however, very extensive.

Oil.

Of the oil used in France, whale-oil forms a very small proportion; the great supply is of vegetable oil, viz. the rape and cole-seed of the north and the olive-oil of the south. The collective value of these is very considerable,—not short (Chaptal, I. p. 186) of L. 3,000,000 Sterling, almost all consumed in France, where lamps instead of candles are in very general use.

Liquors.

Beer, formerly little drank in France, has become of extended consumption since 1790; but even at present, the quantity used does not exceed L. 2,000,000 Sterling, its place being supplied by cyder in the north, and by wine in the south. The consumption which corresponds to that of our home made spirits, and, in a great measure, to that of our rum, is in brandy, of which the value annually made is between L. 2,000,000 and L. 3,000,000 Sterling. Farther, there are at Paris a number of establishments very recently formed for the singular purpose of distilling from potatoes a spirituous liquor which (Chaptal, Vol. II. p. 197) has been generally approved, and has been brought into competition with brandy.

Lesser Manufactures. Hats.

Of hats, an article which in France is made more durable, but much less light and pleasant than in England, the manufactures, formerly concentrated at Lyons and Marseilles, are now diffused throughout several towns; the value annually made is about L. 1,000,000 Sterling. Perfumery is made extensively in the south, where, from the mildness of the climate, aromatic plants are abundant. Paper being exempt from the heavy duties of England, is sold in France on very reasonable terms, while in quality it is equal to our own. The value annually used in printing, in writing, and in the hanging of rooms, is computed at fully L. 1,000,000 Sterling. Of glass, the manufacture has been much improved and extended during the present age. Whether for mirrors, for windows, or for bottles, this article in France is good and of a moderate price. The number of glass-houses in 1818 was 185; the value of their manufacture L. 900,000. As to earthenware, it is only since 1790 that English pottery has been successfully imitated in France. It is now made to the value of L. 200,000 or L. 300,000, while the coarse earthenware, fabricated in almost every province of the kingdom, is computed at L. 600,000.

Saltpetre, till lately a monopolized manufacture, is now unrestricted, and is made to the value of somewhat more than L. 100,000 annually. Sulphuric acid has, since the beginning of the present century, been greatly lowered in price and increased in quantity; its annual manufacture represents a value of nearly L. 300,000. Muriatic acid is used in whitening linen and cotton, and is made to an annual value of L. 100,000. Soda is manufactured in France to the value of L. 100,000; copperas L. 100,000; alum L. 250,000.

Summary of the computed Value of Goods annually manufactured in France.

	L.
Woollen manufactures, fully	9,000,000
Cottons, nearly	8,000,000
Hardware,	9,000,000
Canvas, linen, lace, cambric,	10,000,000
Silk, nearly	5,000,000
Leather,	6,000,000
Jewellery, watches, clocks,	1,500,000
Bronze,	1,500,000
Soap,	1,400,000
Spirituous liquors,	2,400,000
Beer,	2,000,000
Cyder and perry (wine reckoned under agriculture),	2,000,000
Hats,	1,000,000
Starch and perfumery,	1,500,000
Paper,	1,000,000
Glass,	900,000
Earthenware and pottery,	800,000
All lesser manufactures,	13,000,000
Total,	L. 76,000,000

8

Manufactures. General Observations.

Labour in Paris is as much dearer relatively to the provincial towns of France, as labour in London relatively to those of England. It still remains for us to remove from our capital some manufactures, which have been most injudiciously established there; but the French have carried this false calculation much farther, Paris being the centre not only of ornamental fabrics, such as jewellery, bronze, sculpture, cabinet making, but of a number of coarser employments, which a very slight change of plan might transfer to a cheaper quarter. There are at Paris periodical exhibitions of French manufacture held once in three or four years; the last (in August 1819) was very brilliant, and honoured by the presence of the king, the princes, the nobility, and all eminent men of science. There is also in that capital a *Conservatoire des Arts et Métiers,* a collection, on a large scale, of models of all instruments or machines that relate to arts and manufactures.

To make regulations for the mode of manufacture was formerly a favourite course with government in England as in France; but the existence of a representative body, and, above all, the revolution of 1688, caused many of these enactments to fall into disuse among us, at the time when they were maintained among our neighbours with inflexible rigour. From the time of Colbert (1660) the French *ordonnances* prescribed peremptorily the length and breadth of serges, of druggets, in short, of every kind of cloth calculated for export, under the plausible idea, that all these precautions were necessary to establish a reputation for quality. It is a curious fact, that these rules were desired by the manufacturers themselves, and were long considered the safeguard of French industry. A change introduced in 1779, and which gave leave to every manufacturer to follow his own method, provided he distinguished the goods thus made from those that were in conformity with the regulations, was of very short duration. The power of habit and prejudice prevailed. New *ordonnances,* issued the succeeding year, revived the former limitations, and the manufactures of France were not put on an unrestricted footing till the revolution. Much inconvenience had also been sustained from the absurd law which prevented a workman from settling in business in any town, except that in which he had served an apprenticeship. This law was abrogated in 1767.

The manufacturing industry of France is confined, far more than ours, to the home market, whether we look to the supply of the raw material, or to the export of the finished articles. Her imports are large only in cotton and silk; in wool and iron they are not considerable; while in flax, hemp, and leather they may be termed insignificant. In exports the limitation is still more striking; her hardware, her linen, her woollens, her cotton, her leather, and, in a great measure, her silk, being confined to the home market,—a restriction owing partly to our manufacturing superiority, more to the capital of our merchants, and their ability to give long credit. The productive industry of France is consequently much less subject than ours to sudden fluctuation. It follows nearly the same routine year after year. On the occurrence of a war, or other political change, the commerce and manufactures of our neighbours, to borrow a phrase of Talleyrand (Letter to Mr Fox, 1st April 1806), *se replient sur eux-mêmes.* Need more be added, to show the error of those who maintain that, half a century ago, her manufactures were of great amount, that they were almost entirely suspended by the Revolution, and indebted for their subsequent revival to the exertions of the government. The fluctuations, at no time of great amount, have related chiefly to the export trade, and owed their origin to the general hostilities of 1793.

An analysis of the causes of success in manufacture is instructive, as showing that excellence, where it exists, is the natural result of specific causes, and by no means a consequence of that general superiority, the belief of which is so dear to the vanity of every nation. The individual talents of workmen in France and England may fairly be considered on a par; the quickness and activity of the French being counterpoised by their volatility and want of adherence to a given object. The leading advantage of their manufactures is solidity, arising from the comparative cheapness of labour and raw materials. Hence the durability of their woollens and silks. Hence also the cheapness of their paper and leather. The points of inferiority are much more numerous, but may be almost all traced to one cause—an imperfect division of labour. In England, the facility of water communication may be said to unite several towns into one, facilitating the division of employment, and overcoming the disadvantages of a separate and remote position; but in French towns, instead of the inhabitants limiting themselves to a few manufactures of kindred character, there prevails a habit of endeavouring to make every thing on the spot. Lyons, Rouen, Lille, are populous cities, and entitled to rank with Manchester, Glasgow, Leeds; but there must end the parallel; for St Etienne forms a poor counterpoise to Sheffield, and Birmingham, with several of our other towns, is without a rival. In short, it may be assumed generally, that, in a French town of equal size, the work, not only of manufacturers, but of artizans, is, even in the case of ingenious individuals, much less nice and accurate than in England.

It remains to compare the aggregate value of the manufactures of France and Britain. Adopting the amounts given by Colquhoun and Chaptal, we find the manufactures of Britain and Ireland, including mines and minerals, estimated by the former, for the

year 1812, at - -	L. 123,000,000
Supposing the decrease in price since 1812 balanced by the increase of quantity, we have to deduct the Excise and other duties, which, though drawn back on our exports, are included in the above estimate, and form about - -	23,000,000
Value of our manufactures without duties, - -	L. 100,000,000
Of which (see our article ENGLAND, p. 132) there are exported about	40,000,000
Consumed in Britain and Ireland,	60,000,000

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In France, the amount of manufactures, including mines and minerals, is about L. 76,000,000, of which the exports form only	L. 6,000,000
The home consumption,	70,000,000

The large addition for difference in the value of money, which we made in the case of agricultural produce, is not applicable here; several of the articles, as hardware and cotton, being dearer than in England, while others, such as linen, are very little cheaper; so that, on the whole, to bring prices to a level, the calculator ought to take into account the superior durability of several kinds of French goods. The result is, that the population of France, which to ours is as 90 to 60, consumes manufactures only in the proportion of 70 to 60—a difference not a little remarkable, and owing partly to the coarser dress of our southern neighbours, but more to the large proportion of their agriculturists; a class accustomed to make for themselves a variety of articles, both of clothing and furniture, for which the more busy inhabitants of towns resort to the manufactory. This important distinction, viewed in connection with the practice, in French towns, of making articles of all kinds on the spot, will explain a number of points at present involved in obscurity to an English observer; such as the limited intercourse by travelling in France, the want of bustle in the shops, the rarity of extensive partnerships, and the multiplicity of individuals, who, though possessed of some patrimony, are content to follow a petty business, either alone, or with a single assistant—the whole exhibiting a very backward state of productive industry, whether we view it in an agricultural, a manufacturing, or a commercial sense.

Has England reason to dread the rivalship of French manufactures in foreign markets? Not, if we are to draw an inference from the customhouse duties in France, which are maintained less as a source of revenue, than to prevent the introduction of our goods—a singular precaution against a country, where labour is so much dearer. The French are deficient in several main points; in water communication, in fuel, in capital, and, above all, in the habits formed by the long transaction of business on a large scale. We may thus be tranquil in regard to rivalship, from the natives of that or of any country on the Continent; but by no means in regard to the emigration of our own capitalists and workmen, if our present scale of expence and taxation be continued. These would soon find the means of overcoming existing disadvantages. They would carry with them capital and experience. The choice of a maritime situation would obviate the want of canals, and our customhouse restrictions, however they might obstruct the import of their goods into England, would, of course, be unavailing, to prevent their rivalling us in the American or other foreign markets.

VII. Commerce, colonies, fisheries, shipping.

Commerce.

The official returns of French imports and exports were published in a very circumstantial manner previous to the revolution, particularly for the years 1787, 1788, 1789, which were, doubtless, those in which the commercial exchanges between France and her neighbours were carried to the greatest amount. The annual exports then were,

To Spain, above	L. 3,000,000
To Switzerland,	700,000
To Italy,	1,500,000
To Hamburgh (chiefly in sugar from St Domingo),	2,000,000
To the rest of Germany,	2,000,000
To the Baltic,	800,000
To Holland,	2,000,000
To England,	1,500,000
To the Levant, (Of which nearly half to Smyrna.)	1,500,000
To St Domingo and all other parts,	5,000,000
In all,	L. 20,000,000

Of this amount there was in wine, brandy, corn, and other products of the soil,	L. 10,000,000
Raw materials for manufactures,	2,000,000
Manufactured goods,	6,500,000
Miscellaneous articles,	1,500,000

The war of 1793, by bringing in hostility to the French, every contiguous state, except Switzerland, reduced greatly their commercial exchanges; obliging them to desist from exporting a number of articles, and to raise or fabricate others, for which they had depended on their neighbours. This interruption of intercourse continued, either by sea or land, during more than twenty years; and, since the peace of 1814, the relations of the commercial world have been too unsettled to admit of forming conclusive inferences from the returns of any particular year. At present, however, the imports and exports of France are less than before the revolution, and afford a striking contrast to the rapid extension of foreign trade in a country possessing the command of the sea. It is well that our statements, in regard to the manufactures of France, precede the notice of her commerce, as they enable us to conceive with how little foreign intercourse a very numerous population conducts its productive industry.

North of Europe.

The corn, the hemp, the flax, the tallow, which form such important articles of export from the north of Europe to England, are comparatively unnecessary to France. Their timber and pitch are imported there; but the quantities required by a people where ship-building is so limited, are necessarily of little consequence. The farther articles of import are iron, copper, lead, salt, fish, all likewise on a small scale. The returns from France are no longer in the sugar and coffee, which, before the loss of St Domingo, furnished an annual export to the north of fully two millions sterling. They are limited to wine and brandy—luxuries of which the consumption is confined to a few large towns, such as Petersburg, Hamburgh, Stockholm, Dantzic.

With Germany, at least with the centre and south of Germany, the exchanges of France are carried on by a tedious land carriage, or by a still more tedious river navigation. Here are no canals to facilitate

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the conveyance of bulky commodities; all proceed in a slow routine, except horses and horned cattle, which are imported into France in considerable numbers, and made to travel with expedition. In regard to the Netherlands the case is different. With them there is an easy communication by sea, and, as far as regards French Flanders and part of Picardy, a still more easy communication by canals. From the southern part of the Netherlands the imports into France are coal, hemp, flax, fine linen. From Holland, spirituous liquors, spices, butter, cheese. The returns from France are chiefly wine, silks, brandy, dried fruit. When the Netherlands were subject to France, this intercourse was very active; but since 1814, it is much impeded by restrictions on both sides.

From Italy France imports raw silk, corn, rice, olive oil, and fruit, chiefly lemons, oranges, figs, raisins. The returns, various in kind but small in quantity, consist of wine, brandy, cattle, woollens, linen, leather, hats, stockings, jewellery, glass, hardware. From the Levant the imports, though less than formerly, still consist of raw silk, cotton, wool, corn, dried fruits. The exports, manufactured silks, woollens, stockings, and, in a small degree, hardware, paper, liqueurs, linens, lace. With Spain the intercourse is more extensive. The exports from France are corn, flour, salt fish, wine, brandy, also woollens, cottons, silks, leather, linen, lace, hats; all articles that have passed through some process of manufacture, and bear testimony to the industry of the French. The Spaniards, on the other hand, true to their character, make no returns but in produce and raw materials, viz. wool, silk, fruit, sweet wines, along with some iron and copper. With Portugal the trade of France is not considerable, the staple products (wine and brandy) being the same in both countries.

Were congeniality of feeling, either in an individual or a national sense, the regulator of commerce, the intercourse between the French and Americans would be great; for no nations ever sympathized more cordially with the sufferings of each other, or were more decided in ascribing them to the aggressions of England. But a mutual want of capital restricts the connection. The Americans require long credit, and to give credit exceeds the means of the French. The cotton, tobacco, and rice of the United States are paid partly by wine and brandy, but in a very slight degree by manufactures. This branch of trade will increase with the population and wealth of the United States; but the most ready means of extending French commerce would be with England—a country of customers, whose activity supplies them with the means of giving in exchange a number of useful commodities. At present the intercourse is considerable, but a partial reduction of the customhouse duties, on both sides, would extend greatly the imports from England, viz. cottons, hardware, earthenware, copper, tin, coals,—while it would give a correspondent increase to the French exports, of which the staple articles are wine and brandy; the smaller silks, olive oil, fruit, butter, poultry, and, when our laws allow, corn and butcher-meat. In the import of the produce of the soil from France, our course would be clear and direct, our climate not admitting of the growth of the vine, the olive, or the mulberry; but, in regard to manufactures, it is a matter of nicety to say in what articles an exchange would take place, our late improvements in machinery counterbalancing the cheap labour of France in several branches (such as lace), in which our competition would formerly have been hopeless. It is evident, however, that there would be a series of varied and extensive exchanges, not so much perhaps in distinct articles, as in different qualities or shades of quality in the same article or branch of manufacture. These exchanges are necessary for completing assortments in shops, in warehouses, in shipments, and their extent would be such as to be comprehended only by those who are familiar with the endless ramifications of manufacture, or who are aware of the striking exemplification of this truth, afforded by our intercourse with France, in the auspicious interval between the commercial treaty in 1786 and the rupture in 1793. *

Trading Towns.

The chief commercial business of Paris is necessarily inland, but it is the centre of exchange transactions for France, foreign as well as inland; as London is for England, and Amsterdam for Holland. Havre de Grace is the channel of the maritime intercourse of the capital,—the outlet for its exports, and the medium through which it receives colonial produce, raw materials, and foreign manufactures. Bordeaux is a seaport of great activity, as well for the export of wine and brandy, as for the import of sugar, coffee, and cotton. Marseilles, a larger but a less bustling city, continues the emporium for the trade with Italy and the Levant. Nantes has suffered greatly by the loss of St Domingo, as well as by the abolition of the slave-trade, of which it was the centre. It still exports to Martinique and Guadaloupe linen, hardware, printed cottons, and, like Bordeaux, receives, in return, sugar, coffee, and raw cotton. Rouen, though accessible to vessels of burden, is, like Lyons and Lille, chiefly remarkable for manufactures.

Currency.

The currency of France is almost entirely metallic, there being only one bank (*la Banque de France*), the circulation of which is, in a manner, confined to the metropolis; the branch banks at Lyons and Rouen finding it very difficult to extend their issues. The Bank of France is a very solid establishment, possessing funds to the amount of L.4,500,000, while its paper in circulation seldom exceeds L.3,000,000. Though, on all permanent loans, the rate of interest in France is considerably higher than with us, being generally from 6 to 7 *per cent.*, the bank discounts mercantile bills at so low a rate as 4 *per cent.* The amount of metallic currency in France cannot be short of L.80,000,000 or L.90,000,000 Sterling, and the general introduction of bank notes would effect a saving to the nation of L.2,000,000 or L.3,000,000

* See our article on COTTON MANUFACTURE, p. 405.

Commerce, &c.

annually. Saving banks, *caisses d'épargne*, have been lately introduced at Paris.

Fairs.

Land carriage in France costs only from 2s. to 2s. 6d. *per cwt.* for 100 miles; a cheapness which facilitates the transport of merchandise to the various annual fairs which are still held in every great town in the kingdom, exactly as was done by our forefathers a century ago. This periodical routine begins by the *foire de Longchamps*, which is held annually at Paris in spring, and is followed by a long list of provincial fairs, of which the chief are those of Beaucaire in Languedoc, and Guibray in Normandy.

Weights and Measures.

The weights and measures of France were reduced, as is well known, to a very simple and uniform scale soon after the Revolution, but there has been much difficulty in accustoming the inhabitants, particularly in country districts, to the adoption of the new system, which unluckily preserved none of the names with which they were familiar. In 1812, a kind of compromise took place, government sanctioning the retention of the old names, such as pounds, ounces, ells, and bushels, but requiring that their contents should be calculated by a reference to the new standard. It is, accordingly, on this footing that business is now transacted in France. The new weights and measures are, in general, larger by a fraction than the old, and the use of the latter is prohibited by law.

Colonies.

The colonial possessions of France are quite unsuited to her greatness in other respects. The insurrection engendered by the Revolution deprived her of the western half of St Domingo, a rich and beautiful territory containing formerly more negroes, and exporting more produce, than all the British West Indies together. The French government seems to have relinquished the hope of regaining this country, at least by military means, and to limit their ambition to their remaining colonies, Martinique, Guadaloupe, and Cayenne. The two first are, like most of our West India islands, cultivated to a considerable extent, but capable of much improvement. The petty island of Marie Galante is in a similar state, but Cayenne forms a part of a most extensive tract, of which one corner only is as yet rendered productive, and which may eventually become a great settlement, though on the score of health it is as unpromising as the adjacent colonies of Demarara and Surinam. Before the loss of St Domingo the annual import into France amounted to 70,000 hhds. of Muscovado or brown sugar, 60,000 hhds. clayed, and nearly 20,000 of fine clayed. Of this very large supply there were exported nearly 40,000 hhds. of brown, and above 60,000 hhds. of clayed, forming, exclusive of any duty, an annual value of between L.2,000,000 and L.3,000,000 Sterling, and affording a most acceptable exchange for a number of imported commodities. But the far greater part of this import has long been lost to France, no sugar is now exported from that country, while, of the quantity required for its consumption, and amounting to about L.2,000,000 Sterling, a considerable part is received from England and the Spanish West Indies.

In Africa the French possess Goree and some factories near the mouth of the Senegal. In the East they have, in the isle of Bourbon, as in Pondicherri, Chandernagore, and some smaller factories on the mainland of India, the means of carrying on commercial intercourse, and their vessels are, like the Americans, admitted to trade with Calcutta, Madras, and other British settlements, on payment of moderate dues; but they possess no power of annoying or even of resisting us in the event of hostilities. The retention of the Isle of France, at the peace of 1814, deprived them of the great receptacle for their privateers in the East; and, in a very different part of the world, the continent of North America, they retain nothing since the cession of Louisiana in 1803. In the seas of Europe, Corsica is almost the only insular possession of the French. They have no great maritime fortresses, like Gibraltar or Malta, and no dependencies of the nature of the Ionian islands.

Fisheries.

The fisheries of France are composed, like our own, of those on the coast and those at a distance, particularly at Newfoundland. All along the north coast of France, the fisheries consist, as on our side of the Channel, of cod, mackerel, herrings, and pilchards. On the shore of the Atlantic, and still more on that of the Mediterranean, are caught great quantities of sardines, a fish of passage, which appears periodically in shoals like the herring. The tunny, a fish not known in northern latitudes, is found in the Mediterranean in the early part of summer. It varies in weight from 10 to 25 lbs. and is in like manner caught in shoals. These home fisheries, little calculated for forming seamen, have been left to their natural progress, while repeated attempts have been made by government to extend the fishery in America,—a design favoured by the early possession by France of Newfoundland and Canada, as well as by the long peace that followed the treaty of Utrecht. Towards the middle of last century the French fisheries in America employed annually about 5000 seamen, but the unsuccessful contest with England in 1756 reduced them greatly, and deprived them of their principal station, Cape Breton. The peace of 1783, concluded under better auspices, renewed their right to fish on the banks of Newfoundland, a right subsequently acknowledged by the treaties of 1802 and 1814; and though their only permanent possessions for this purpose are the small islands of St Pierre and Miquelon in the Gulf of St Lawrence, the continuance of peace can hardly fail to give a considerable extension to this fishery. The Greenland fishery presents a less flattering prospect. It was attempted in a former age by the inhabitants of Bayonne, and lately by those of Dunkirk,—a place much better situated for it,—but in either case the shipping employed was inconsiderable, and the whole is subject to capture and stoppage by our superior marine in time of war.

Shipping.

In this respect France was always inferior to England, and a comparison is wholly out of the question, since the loss of St Domingo, and the almost total extinction of the mercantile navy of France by a

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war of twenty years. Since 1814 attempts have been made by the ship owners in Havre de Grace, Bordeaux, Marseilles, Nantes, St Malo, to re-establish their shipping, but as yet with very limited success; the deficiency of capital, the want of colonies, the fluctuations in trade, the dread which, however unfounded, is general among the present generation, that England will not long allow them to enjoy peace, having all concurred to discourage their efforts. No returns of the mercantile tonnage or seamen are made to the French parliament, but the insignificance of both in the foreign trade is apparent from the annual lists of vessels passing the Sound, or frequenting the great foreign ports, such as Hamburgh, Amsterdam, Cadiz, Leghorn, New York. The intercourse between France and America is conducted chiefly in American bottoms; that between France and the Netherlands in Dutch; and still more that between France and this country in British. Of the packets, that cross the Channel in such numbers since the peace, nine-tenths are British. A solitary French vessel appears, from time to time, in our ports with a cargo of provisions or of fruit. On the other hand, the coasting trade of France is very considerable, the commodities conveyed (chiefly corn from the north, and wine from the south) requiring a great deal of tonnage, and the still more bulky article of timber being occasionally transported by coasters.

VIII. Religious and charitable establishments.

The condition of the church and clergy forms a most important feature in the history and present situation of France. In former times, the Gallican church, without desiring a separation from the Holy See, had often advanced a claim to independence, and maintained long and animated discussions, or rather controversies familiar to those readers of French history, who have attended to the history of the Jansenists and Molinists. The result of these and of the general progress of knowledge in France was an exemption from a part at least of the interference in ecclesiastical affairs, exercised so despotically by the court of Rome, in Spain, Portugal, and Italy. As to pecuniary means, though the income of the lower ranks of the clergy was extremely small, the church of France was in the whole richly endowed; the rent of land and houses, appropriated to abbeys, priories, bishoprics, archbishoprics, and benefices of every description, being computed at five millions sterling, exclusive of the tithes levied, with more or less strictness, throughout the whole kingdom. As a political body, the French clergy were differently situated from the English, having no voice in legislating, but aiming at, and frequently attaining, the highest offices in the executive government.

In 1789, a number of the clergy, both in the upper and lower ranks, participated in the general wish for a political reform, and evinced that disposition, by their readiness in coalescing with the *Tiers Etat*, at a time when the majority of the *noblesse* refused to do it, until compelled by the call of the people, and the positive order of the court. In the highly interesting discussions that ensued during the years 1789 and 1790, several of the leading orators were Catholic clergymen, nor did they in general take the alarm, until the menacing aspect given to public affairs by the too rapid progress of the Revolution. The National Assembly stripped the church of her lands, and declared them the property of the public, providing, indeed, for the income of the clergy, but making the payment of it dependent on government. All this might have passed and been forgiven in the ardent hopes of national benefit from the Revolution, but the Assembly did not stop here. Considering both the court of Rome and the court of France inveterately hostile to the Revolution, they determined to detach the clergy from both, and sought to compel their adherence, by imposing on them an oath of fidelity to the new constitution, on pain of forfeiture of their livings. The sincerity of the clerical body was now put to the test, and a striking proof was given of their being actuated by that conscientious feeling, for which the public in Protestant countries are so little disposed to give them credit.—In every rank, whether prelates, curates, vicars, or the humble *desservants*, the majority preferred the hazard of losing their livelihood to taking an oath at variance with their conscience. The violent party continued to triumph at Paris, and the non-conforming clergy had no alternative, but to fly their country. Hence the crowds of emigrants, who, in 1791 and 1792, sought refuge in Italy, Germany, and, above all, in England. Those who remained in France were exposed to all the atrocities of the Jacobins. Hundreds of them were sacrificed in the massacres of September 1792, and hundreds were brought to the guillotine in the dreadful years 1793 and 1794. With the fall of Robespierre (July 1794) the executions ceased; but a tone of hostility to the church was still kept up, and accounted an indispensable part of the policy of the revolutionary government. The only class allowed to remain in quiet were the *curés*, whose humble station and scattered position created no political alarm. It was not till the established sway of Bonaparte (in 1801) that circumstances admitted of cooler calculation, and enabled that artful usurper to seek, in a hierarchy, a prop to his own power, and an engine of opposition to the liberal party—to that party which still hoped to secure to France advantages from the Revolution. With this view, he affected great respect for the Catholic church, passed a Concordat with the Pope, and made a pecuniary provision for a specified number of Sees. His next step was to frame and circulate throughout all France a catechism, calculated to impress the rising generation with a profound veneration for a sovereign, who had been "anointed by the Pope, and received his mission from the Almighty." The power of Bonaparte received in this manner a most substantial support, and would have taken deep root with the lower orders, had he not counteracted it by his subsequent quarrel with the Pope, which assumed an angry aspect in 1809, and became more and more aggravated during the remainder of his reign.

On the restoration of the Bourbons in 1814, the

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Catholic clergy hailed the change with enthusiasm; but the public, at least the great majority of the middling classes, soon showed a marked distinction between their cause and that of the king. The conduct of Louis, in regard to the clergy, has been marked by moderation and judgment. Religious himself, he has sought to revive similar impressions among his subjects, to enforce the observance of the Lord's day, and to relieve from indigence the *desservants*, or country curates. But he has placed no clergymen in political situations, nor made any attempt to give the bishops or archbishops seats in the House of Peers. The error of the King, or rather of the Church, consists in not abrogating the superstitious and puerile part of the Romish ceremonial. Processions still take place along the streets, accompanied by the throwing up of incense, the strewing of flowers, and the unmeaning practice of hanging folds of linen for many hundred yards along the front of the houses. Another and more serious injury to productive labour is the observance of saints' days, an observance which, though not enforced by penalties, is enjoined by the precepts of the clergy, and the practice of government.

Concordat.

A *Concordat*, or compact between the pope and the king, is a transaction of high importance in a Catholic country, where the public are impressed with the belief, that, in all that relates to religion, reference ought to be had to the court of Rome, and that their temporal sovereign possesses authority in such affairs only, as far as it is delegated by the Holy Father. The object of a *Concordat* is to define the respective powers of the Pope and King. In France the aim of the executive government has long been to secure the patronage of the church, and to stipulate that no bulls, briefs, decrees, or other acts of a nature to agitate the public mind, should be promulgated without the royal sanction. Three centuries ago, when the alarm of the Reformation, and some urgent political considerations, made it of importance to the court of Rome to attach to its cause the reigning sovereign of France, there was passed between Leo X. and Francis I. a *Concordat*, declaring that the power of nominating the archbishops and bishops of France resided in the crown, the sanction of the pope being required only for their inauguration (*institution canonique*). This compact was considered a kind of charter, or standard document, in the long discussions which afterward ensued about the independence of the Gallican church, until the whole sunk into insignificance before the storm of the Revolution. During the ferment of that convulsion, the Jacobins, and even the Directory, made no proposition for accommodation with the Holy See, and bade, or affected to bid, it defiance. Bonaparte, more politic, concluded a Concordat, which, though it reinstated only 50 of the 130 Sees existing before the Revolution, stamped him, in some measure, a restorer of the church. That he did not afterwards augment their number is to be accounted for solely by a dread of alarming the revolutionists. The Bourbons, on their restoration, appear to have felt all the delicacy of such a measure; and nothing favours the probability of the charge of their intending to restore the lands, the tithes, or temporal influence of the clergy. Negotiations for a Concordat were early begun with the court of Rome, but its conclusion was delayed till 1817, and the interest with which it was received in France can be comprehended only by persons resident among a people still agitated by political division, and dreading the influence of the clergy, as an engine for the revival of all past abuses. From this, and from differences with the court of Rome that are foreign to our subject, the execution of the new *Concordat* has been very tardy. Of the 42 additional Sees appointed by it, a considerable part are still vacant.

The prelates of the church of France are as follows:

Cardinals, at present five in number, with an annual income of nearly			L.1300 Sterling.
18 Archbishops, average income about	. . . . .		800
74 Bishops,	do	about	600

The next in rank are the vicars-general, to the number of more than 100; and the chanoines or canons, who also exceed 100; after which come the *curés* or established curates, in number nearly 3000, and divided into three classes (first, second, and third), with incomes of only L. 40, L. 50, or L. 60, but with certain emoluments, from surplus fees, which vary according to the population of their respective districts. Lastly come the *desservants* or acting curates, of whom there is one in almost every country *commune* or parish in the kingdom, amounting, in all, to above 23,000, but with incomes of only between L. 20 and L. 30 a year; a pittance equal to about L. 40 in England, but still too small to provide for even the limited wants of a state of celibacy. There are also a number of *succursales*, or chapels, appended to large parishes; but of these a considerable number (at present about 2000) are vacant from want of funds, bad repairs of the building, and other causes. These various appointments are all paid out of the public treasury. The expence of the Catholic church to the nation is (Budget 1819) L. 1,100,000 Sterling a year, but as there are other heads of disbursement, particularly salaries to Protestant ministers, the total ecclesiastical charge is about L.1,300,000.

The nomination of all clergymen, whether Catholic or Protestant, is vested in the crown. As to political feeling, the Catholic clergy are, almost without exception, hostile to the interests produced by the Revolution, and attached to the Bourbons.

Convents.

Female convents have, all along, existed in France, with the exception of a few years of the worst part of the Revolution, when their inmates were obliged to forsake their establishment, and to seek an abode with their relations. Monasteries are, with very few exceptions, abolished, and no idea is entertained of re-establishing the abbeys, priories, and other endowed establishments; the Bourbons and the court of Rome having repeatedly pledged themselves not to disturb the revolutionary purchasers of the church-lands, and to appropriate to ecclesiastical purposes

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only that proportion of these lands that remains unsold.

Effects of the Revolution on Religious feeling.

What, it may be asked, have been the effects of the Revolution on the state of religion in France? It has subverted the power of the church, and, what is much more serious, the belief of Christianity in the minds of the young and the middle-aged of the male part of the population; but, with the elders of that sex, and with almost all females, the Catholic creed preserves undiminished sway,—a sway that extends much farther than can readily be conceived by Protestants. The extent of this influence is owing to various causes; in part to commendable conduct in the clergy, who, in general, act the part of careful pastors, and attentive visitors in sickness or distress; but, in part also, to that blind credulity with which the tenets of the church are received both by the hearers and their spiritual guides, whose education has, by no means, kept pace with the general progress of knowledge; for it does not embrace the philosophical course of the universities of France, but is conducted in separate seminaries, and on a much more confined plan.

Protestants in France.

The Protestants in France amount to above 2,000,000, and are most numerous in the south, particularly at Nimes and its vicinity. They are almost all adherents of the Revolution, and a political change, such as that which twice took place in 1815, could not be accomplished in a divided community without a contest; but the alarm then so loudly raised in England in their behalf was founded on exaggeration. The Bourbon government receive with attention the applications of the Protestants, whether for increase of pastors or repair of churches. On the whole, the Protestants of France form an industrious and valuable portion of the population, but they are animated by a strong *esprit de secte*, by a feeling approaching to animosity towards the Catholics, and, till of late, by a considerable distrust of the reinstated government.

Charitable Establishments.

Before the Revolution the poor in France, as in Italy and other Catholic countries, were supported chiefly by the abbeys, priories, or other beneficed establishments. On the absorption of these sources of income by the revolutionary government, a provision for the poor became a subject of legislative inquiry, and, after long investigation, it was decidedly determined to avoid a poor-rate on the English plan, but to provide for the aged and helpless an annual fund to the proposed amount of L.2,000,000 Sterling. Several years elapsed before this was acted on, and the fund eventually provided consisted of a revival of part of the old *octrois*, or dues levied on wine, cyder, spirits, and other articles of consumption, on their entrance into towns—a tax from which the Revolution had lately relieved the public, and which was now disguised under the specious name of *octroi de bienfaisance*. These dues, however, were soon extended and applied to the general expenditure of the government, after retaining a portion which at present constitutes the only regular fund for the poor. Farther sums are collected by subscription in the depth of winter, or on the occurrence of extraordinary distress. From the public treasury, likewise, there are made occasional issues, in a season of hardship, on the application of the mayors or local magistrates. There are at Paris a number of hospitals, of which by far the largest is the Hotel Dieu. In the provincial cities there are, in general, two hospitals for the poor, one for the sick, the other for the aged. Of other charitable institutions, the principal are the *Sociétés de charité maternelle*, or associations on a large scale, at Paris and some of the chief towns, for the aid of indigent women in childbed. Mendicity is not restricted in France, and prevails in many places to a reprehensible degree.

IX. Establishments for the purposes of education and science.

Education.

Education, before the Revolution, was conducted in schools, colleges, and other establishments of old date, at the head of which stood the University of Paris. The provincial universities, twenty-two in number, were of far inferior note, a few only, such as Montpelier, Dijon, Strasburg, Caen, possessing a reputation above mediocrity. Boarding-schools (*pensionnats*) were established in the towns, but in much smaller number than in England, female education being managed chiefly in convents. There existed throughout France a number of foundations attached to monasteries, schools, and universities, for the purpose of education, the collective income of which was said to amount to L. 1,000,000 Sterling. These funds were involved at the Revolution in the same vortex as those of the church, but with a pledge on the part of government, to take on itself to provide for the national education on an improved footing. This object, interesting under any circumstances, and at that time doubly so, from the necessity of attaching the rising generation to the new doctrines, was delayed, amidst the confusion of public affairs, until 1796, when there was passed an act, which, along with many other provisions, directed that schools of two kinds, primary and central, should be established throughout the country. But new troubles retarded the execution of this plan, particularly in regard to the primary or elementary schools. Hence the very defective education of the youth of the lower orders in the interval that elapsed between withdrawing the gratuitous aid of monasteries, and establishing schools on the new plan. Next came the reign of Bonaparte, who, considering education merely as an engine for consolidating his power, placed, by a special act, all the seminaries of the empire under the control of *le Grand Maitre et Conseil de l'Université de Paris*, who delegated this important charge to a board called *Commission d'Instruction Publique*. This board is maintained by the Bourbons, and it is remarkable that the opposition in the French Parliament acquiesces in the principle of placing the superintendence of education in Government,—a principle as contrary to their tenets as to the established usage in England; but admitted by them from a dread that education, if uncontrolled, would fall into the hands of

Education. the clergy, and the rising generation be trained in the prejudices of their forefathers.

Universities. Though the name of University has been of late years exchanged by the French for the more unassuming title of Academy, we prefer using it, as their *Academies* are in fact similar to our universities. Their number (26) is nearly equal to that of the *Cours Royales* (see in the sequel the section on Law), and the towns where they are situated are, with very few exceptions, the same, viz.

Aix	Dijon	Orleans
Amiens	Douay	Paris
Angus	Grenoble	Pau
Besançon	Limoges	Poitiers
Bordeaux	Lyons	Rennes
Bourges	Metz	Rouen
Caen	Montpelier	Strasburg
Cahors	Nancy	Toulouse.
Clermont	Nismes	

The University of Paris is on a large scale, and comprises a greater variety of classes than any other seminary in Europe, whether we look to medicine, law, science, belles lettres, or theology. Of the provincial universities, some are on a more extensive plan than others, and appropriated, by preference, to the study of particular professions; but, on the whole, they approach nearer to the comprehensive aim of the Scotch, than to the simplicity and uniformity of the English colleges.

Facultés de Droit (classes for a course of law) are held in the following:

Aix	Grenoble	Rennes
Caen	Paris	Strasburg
Dijon	Poitiers	Toulouse.

The *Facultés de Medicine* are confined to Paris, Montpelier, and Strasburg; and every medical man who aims at a thorough knowledge of his profession repairs to the capital, for the sake, not only of the classes, but of the hospitals, which are there on a very large scale. Classes of *Sciences et Lettres* are held in the following universities:

Besançon	Grenoble	Strasburg
Caen	Montpelier	Toulouse.
Dijon	Paris	

Of *Theology* there are *facultés* at the following places:

Aix	Lyons	Rouen
Bordeaux	Paris	Toulouse.

The Protestants have theological seminaries at two towns remote from each other, Montauban and Strasburg, and students who have gone through their course at Geneva and Lausanne are eligible to clerical charges in France.

Lycées. While the establishment of elementary schools went on tardily, the case was very different in regard to the *Lycées*, or great schools frequented by the sons of the middle and upper classes.—These were the objects of Bonaparte's care, both as a nursery for officers, and as a means of interesting the parents in his government. With that view he provided them with a number of *bourses* or scholarships, and put the discipline of the whole under the direction of the *Commission d'Instruction Publique*, at Paris. A Lycée consists, in general, of a spacious range of stone buildings, like one of the Colleges in an English University, with courts and play grounds, the whole inclosed with walls. The pupils, at least those who board in the establishment, are under considerable restraint, and go out only with the leave of the *proviseur* or superintendent. Of the objects of education, the principal are Latin and mathematics; the former occupying four or five years, the latter generally two. Along with these are taught writing and drawing; also geography and history; to which, in the time of Bonaparte, was added the military exercise. The whole course occupies six, seven, or eight years, according to the aptitude of the pupil. The teachers, or professors, as the French complaisantly style them, are, in general, men of education, but seldom animated with that spirit of activity and vigilance which would be formed in an establishment exclusively their own, independent for its increase on their personal exertion. As to expence, the board and education of a boy, at a Lycée, costs from L. 15 to L. 30 in provincial towns, and L. 36 at Paris. On these payments is levied a tax of 5 *per cent.*, called *taxe universitaire.* A similar impost exists on private schools, with the exception of those for mere reading and writing; and the money thus collected is remitted to the Central Board at Paris. To this fund is added, by the Chambers, an annual vote of from L.60,000 to L.80,000, and the whole is appropriated to purposes connected with public education; in particular to the salaries of the teachers of the less frequented Lycées. Public examinations are held at these establishments, and prizes distributed periodically—the whole on a plan calculated to excite emulation; but no consideration can justify the monopoly of teaching granted to Lycées by Bonaparte, and not yet withdrawn by the Bourbons—a monopoly which empowers the inspector of a Lycée to prevent Latin being taught at private schools. This and other abuses it has been repeatedly proposed to correct, by a definitive law on public education; but that measure, from the urgency of other business, has been postponed from year to year.

Primary Schools. Of the lower orders in France, whether in town or country, it is computed that not more than the half are taught to read, in consequence, chiefly, of the want of schools in thinly-peopled districts. The legislature has, at different times, particularly in February 1816, acknowledged this want, and authorized rectors of universities to grant certificates of capacity as teachers to all persons who should be found duly qualified; but no salary is provided, and the aid given by the magistrates of a *commune* is, in general, limited to a school-room or dwelling for a teacher. In this state of education, schools on the plan of Bell and Lancaster could hardly fail to be favourably received in France. They bear the name of *Ecoles d'enseignement mutuel*; and are at present (1820) in number nearly 800; the scholars amount

Schools on the plan of Bell and Lancaster.

Education. to 80,000. These schools are scattered throughout the kingdom, having been adopted or declined according as the inhabitants or magistrates of a provincial town were disposed in favour of them, or of the rival Catholic establishments, managed by the *Freres de la doctrine Chretienne;* a body of teachers supported by the Catholic clergy, while the schools of *enseignement mutuel* are patronized by the *liberaux,* or moderate revolutionists. Government has taken no decided part, but has given its sanction to either, as desired by the inhabitants of particular districts. The new plan is, however, acquiring a decided preponderance, the schools of the *Freres de la doctrine* not exceeding 150 in number. *

The *Ecole Normale* is a seminary at Paris for training teachers, who are, in general, young men of talent, and receive appointments as masters of schools of the second class, or as assistant teachers at the Lycées. The course lasts generally three years, and the number of students, formerly 70 or 80, is now only between 50 and 60. The education of girls in France takes place partly at boarding-schools, partly at convents. Of the total number of pupils at the seminaries of France, great and small, the latest return was, in 1815, as follows:

	Seminaries.	Pupils.
Universities, - -	26	6,329
(Of this number two-thirds study law and medicine.)		
Lycées, now called *Colleges Royaux,*	36	9,000
Schools of the second class held in towns, - - -	368	28,000
Divinity schools, exclusive of the *Facultés de Theologie,* -	41	5,233
Boarding-schools, - -	1,255	39,623
Schools of the first class (*écoles primaires*), answering nearly to our parish schools, - -	22,300	737,379

Institute. The Institute, established during the Revolution, and treated all along with distinction by Bonaparte, has been maintained by the Bourbons without any material change, except its division in 1816 into four academies. Each academy has the separate management of its affairs, but the library, the secretarial department and the collections remain common to all. The *Académie Française,* composed of forty members, is charged with the department of the French language; that of the *Inscriptions et Belles Lettres,* with antiquities, monuments, history, and the moral and political sciences connected with history. The *Academy of Sciences* is divided into a number of sections, partly for Mathematics, partly for Natural History. That of the *Beaux Arts* is also divided into sections, viz. for painting, sculpture, architecture, engraving, and music. A fund is allotted annually by government to pay the salaries of the members of the Institute, the secretaries, and other persons employed; also for scientific experiments, prizes, &c. The prizes annually distributed by the *Académie Française* and of *Inscriptions* are of the value of L. 60; and of twice that value from the Academy of Sciences. The *Académie des Beaux Arts* gives annual prizes in painting, sculpture, architecture, and music, one for each, and the candidates who gain them are sent to Rome to study at the expence of government. The number of *Académiciens* is about 200, exclusive of honorary members (*Académiciens libres*), who are generally public characters of eminence. In electing new members, the usage is for the Academy to nominate and present their choice for confirmation to the King. Each of the academies has its correspondents in foreign parts.

Establishments for the purposes of War.

X. Establishments for the purposes of war.

Army. The French army first assumed a regular form under Henry IV.; but its peace establishment, including both horse and foot, did not then exceed 10,000 men, while the whole charge for the war department, including ordnance and half pay, was L.500,000. In 1610 Henry carried his army to a war establishment of 40,000 men. In 1640, under the able administration of Richelieu, France took an active part in the war of Germany, carrying her force at one time to 100,000 men, and her expenditure to the then unexampled sum of L.4,000,000 Sterling in one year. In 1659, Louis XIV., already full of ambitious projects, kept up a peace establishment of 70,000 men; and the war of 1672, having brought Germany, Holland, and Spain, into the field against France, the force of the latter was carried to the number of 160,000 men. From 1679 to 1688 there was peace, but Louis passed the interval in preparing for war, and the introduction of the funding system now enabled France, England, and Holland, to surpass all their former exertions. The contest begun in 1688 required on the part of France a force of between 200,000 and 300,000 men. The peace of Utrecht gave a long repose to exhausted France, and the war of 1741 did not, until conducted in its advanced stage by Marshal Saxe, call forth a military force equal to that of Louis XIV. In the war of 1756, the French army was less numerous, and far less ably commanded. During the continental peace of thirty years (from 1762 to 1792) its establishment was kept, with little fluctuation, at 100,000 men.

The war of the Revolution began with a force on the part of France † of only 140,000 men; but this was speedily augmented by the compulsory levies of February 1793, and by the still more comprehensive operation of the requisition in September. The republican spirit was now at its height, and the unlimited issue of assignats led to the maintenance of a force, hitherto unexampled in the annals of any country, ancient or modern. In 1794, the French-

* *Rapport par* M. Jomard *sur le progrès de l'enseignement mutuel.*
† Jomini, *Traité des grandes operations militaires.*

Establishments for the purposes of War.

men in *actual service* in the Netherlands, on the Rhine, in Piedmont, the Pyrenees, and the Vendée, appear to have amounted to between 500,000 and 600,000, a force, which, though imperfectly disciplined and officered, baffled the greatest confederacy that had at that time been formed in Europe. In 1795 the assignats lost their power, and France was obliged to reduce her army by a third, but its discipline was now greatly improved. During the campaigns of 1795, 1796, and 1797, as well as in those of 1799 and 1800, the force maintained by France and Holland was between 300,000 and 400,000. At the peace of Amiens, Bonaparte kept up a peace establishment of 300,000 men, and after the renewal of war it was raised * to 400,000, a force with which he triumphed in 1805 over the united arms of Austria and Russia. His annual levy of French conscripts, though apparently only 80,000, amounted (Declaration of the Minister at War, 18th September 1809) to 100,000; a supply which, joined to the recruits of his allies in Germany and Italy, kept up his numbers, and even increased them, notwithstanding the wasteful campaigns of 1806 and 1807 in Poland, followed by the no less wasteful campaigns of Spain. In 1812 the force of France and her allies reached their *maximum*, Bonaparte having led against the Russian Empire a mass of 360,000 men, while there remained in Spain, Germany, and France, a number which carried the aggregate to between 500,000 and 600,000. Need we then wonder, that, even after the almost total loss of his troops in Russia, there remained a force competent, with the aid of fresh levies, to withstand the efforts of the allies during two campaigns?

In 1815, Bonaparte, in returning from Elba, found under arms in France about 120,000 men, all of whom, with the exception of a few thousands, rejoined his standard. But so sick were the French of war, that the greatest efforts, during the next three months, added only 60,000 to this number, and the loss of one battle exposed all the hopelessness of resistance to the allies.

On the second restoration of the Bourbons in 1815, the army had fallen into a very disorganized state, the disciplined soldiers being dispersed, and the ranks slowly filled by new levies. In the end of 1817, the public saw, with surprise, the Bourbon government propose a recurrence to the conscription as the only effectual method of filling the ranks with men of steady habits; for the army in France, never a receptacle for the refuse of the populace, has, in general, been composed of young peasantry and labourers of good character. Such was its constitution in the war of the Revolution, and its discipline was exemplary, until Bonaparte adopted the unfeeling practice of making war without magazines, and obliged the soldiers to live at free quarters on the inhabitants. The new conscription is indeed greatly modified, the numbers annually required being limited to 40,000, and the term of service to six years; still the measure is compulsory, and falls heavy on the middle and lower classes; the alternative for a youth, when drawn, being either to give up his intended profession or to pay L. 40 or L. 50 for a substitute. In 1819, the French army amounted to 100,000 men; it was soon after considerably increased, and will ere long be carried to 150,000, a number likely to form the permanent peace establishment. This force is composed of

Guards.

The guards, a numerous corps, consisting of sixteen regiments; viz. eight of infantry, eight of cavalry; each of the former of three battalions; each of the latter of six squadrons.

Cavalry.

The cavalry of the line comprises, under the various denominations of chasseurs, dragoons, cuirassiers, and hussars, in all forty-eight regiments, but in peace they are on a reduced scale.

Infantry.

The infantry of the line, classed during the Revolution by brigades, and under Bonaparte by regiments, is now (since February 1819) classed by legions, of which there is one for each department, making in all eighty-six, each generally of three battalions: the total number of battalions is two hundred and fifty-eight.

Artillery and Engineers.

The artillery is composed of eight regiments serving on foot, and of eight regiments of horse-artillery. The engineers are a numerous and well educated body of officers; the corps of *Ingénieurs Géographes* comprises five colonels.

The Swiss.

The Swiss troops in the French service amount to 10,000, of whom above 4000 are in the guards.

Maison du Roi.

The *Maison du Roi*, or body guards, are a select corps of young men of family, who go through this service as an introduction to the military life.

The gradations of rank in French service are, *sous-lieutenant, lieutenant, capitaine, chef d'escadron, colonel, maréchal-de-camp, lieutenant-général, maréchal de France.* The number of the marshals of France will henceforth be limited to twelve; the number of the other ranks, even that of *lieutenant-général*, is very large, for the *etat major*, or staff of the army, after a reduction in 1818, consists of 130 *lieutenants-généraux*, and 260 *maréchaux de camp*. There are on full pay twice as many officers as are necessary for the duty, but the number of half-pay officers exceeds all proportion; for this part of Bonaparte's vast machine has remained, while most of the private soldiers have sunk tranquilly into the occupations of the lower classes.

Promotion in the French army never takes place by purchase, and not often by special order; seniority at present determines more than half the appointments, a course which, while it renders promotion extremely slow, will eventually give employment to almost all the half-pay officers. Of the soldiers in service, there is still a part of the army of Bonaparte, but the majority are recent levies.

Ecole Polytechnique.

Of the military seminaries of France, the one of highest repute is the *Ecole Polytechnique*,—a school for the instruction of young men in mathematics, and drawing for the engineer and artillery corps; none but candidates of talent are admitted, and it is

* *Tableau Historique des Guerres de la Revolution.*

Establishments for the purposes of War.

well entitled to the name of a nursery (*pepinière*) of intelligent officers.

Expence of the Army.

The charge to government of a foot soldier in France does not, in time of peace, exceed L. 20 a year; that of the cavalry soldier is nearly double. The pay for either officer or soldier is little more than half the rate in England, and its inadequacy is much complained of. The whole charge of the war department under Bonaparte was about L. 20,000,000 Sterling; at present it is about L. 6,000,000.

Gendarmerie.

The gendarmerie are not a part of the regular army, but a corps charged with the police duty, and scattered in small divisions throughout all France; their total number, including officers, is 18,000.

Gardes Nationales.

The *gardes nationales* correspond to our yeomanry and volunteers; every town of consequence has a corps of this description.

Fortifications.

The chief fortifications of France, on the side of Flanders, are the well-known towns of Lille, Valenciennes, Condé, Douay; on the side of the Alps, Embrum, Grenoble, Antibes; on the side of the Pyrenees, Perpignan, Bellegarde, Mont-Louis, Bayonne. The fortified seaports are Brest, Toulon, Cherburg, Rochefort, Boulogne. France is, without question, the first military power on the Continent, being nearly equal to Russia in population, and greatly superior in pecuniary resources, as well as in the intelligence of the individuals that compose her army.

Navy.

The superiority of the English navy over the French existed in ages when our pecuniary means were far inferior; and though, during the middle of the reign of Louis XIV. the French, by financial sacrifices, obtained a numerical superiority, one great battle, that of La Hogue in 1692, was sufficient to restore our ascendancy. The war of 1741, however successful on the part of France by land, was, particularly towards its close, unfortunate to her at sea. In the succeeding interval of peace, great efforts were made to reinstate the French navy, but the war of 1756 proved doubly disastrous, and at last swept it almost entirely from the ocean. A very different scene opened in the war of 1778, when France, unembarrassed by a continental struggle, was enabled to direct all her disposable resources to her marine. She was then enabled to keep in an effective state about seventy sail of the line, the crews of which, added to those of the frigates and corvettes, formed a total of 60,000 seamen. The blows given to this force by our navy, towards the end of the war, were repaired with great diligence in the peace; and to prepare young officers for the sea in preference to the land service, became a favourite object in several of the government schools. In 1791, an official report stated the effective French navy at seventy-four sail of the line, sixty-two frigates, and twenty-nine corvettes; a state of preparation which accounts for the resistance made to our navy by the Revolutionary government under all the disadvantages of an unparalleled continental struggle. This proud force, however, disappeard progressively at the capture of Toulon, the victory of 1st June 1794, and still more in the victory of Aboukir, so that Bonaparte, on his accession to power, found the French marine in a very reduced state. He laboured, however, to reinstate it; the years of continental peace, 1801, 1802, 1803, 1804, were favourable to his efforts, and, in 1805, he boasted of having in equipment sixty sail of the line, a force destined to an early diminution at Trafalgar and St Domingo. The Bourbons, on recovering their crown, found little more than half the force that existed previous to the Revolution. It has since received a small augmentation, and amounts at present (1820) to forty-eight sail of the line and twenty-nine frigates, with eleven of the former and four of the latter on the stocks; but there are in active service only five frigates, three corvettes, and from eighteen to twenty schooners and cutters. The annual vote for the navy is only L. 1,800,000, not one-third of the same head of charge in England. *

Revenue and Expenditure.

XI. Revenue and expenditure.

Revenue.

Though England is at present so much more heavily taxed than France, the case, in former ages, was very different. The want of a representative body in that country led to the pernicious practice of farming the taxes, and of permitting the contractors (*traitans*) to make many undue extortions from the people. Sully first endeavoured to moderate these exactions. After him the most assiduous financier was Colbert, who carried, in 1682, the revenue of France to L. 5,000,000 Sterling, at a time when the English revenue did not exceed a third of that sum. The long and expensive wars of Louis XIV. produced a great accumulation of debt (nearly L.100,000,000 Sterling), which, after his death, was lessened by an appeal to a singular privilege, of which advantage has often been taken in France, viz. that a new sovereign is not bound to pay the debts of his predecessor in full. During the eighteenth century the revenue of France increased progressively, but more slowly than that of England; the vicious system of farming the taxes still continued. Necker, appointed to office in 1776, sought to teach the French court the value of publicity in financial statements, and gave the rare example of a war conducted for several years without new taxes, the supplies being found by loans, the interest of which was provided for by successive retrenchments in the public expenditure. His successor, M. de Calonne, pursued a very different course, and was found altogether incapable of the measures necessary to remedy an annual deficiency of L.2,000,000 which now took

* The convicts sent to the galleys in France work under the direction of the Admiralty, and as that punishment holds in France the place of transportation, the number thus employed amounts to between 10,000 and 12,000.

Revenue and Expenditure.

place. The revenue of France was then about L.22,000,000 Sterling. The sum required * for payment of the interest of the public debt was nearly L.10,000,000, leaving only L.12,000,000 for the army, navy, civil-list, and other public expences.

Such was the state of the French finances at a date soon followed by invasion on the frontier, and, in the interior, by all the confusion of the reign of terror. In the era of confiscation and judicial murder, the national debt could hardly be respected. It was not, however, openly cancelled, but the interest was issued in assignats of no value except for purchases of national property. At last, in 1798, on an approximation to regularity in the management of public business, there was passed a law, declaring that one-third of the old national debt should be sacred, and the interest on it payable in *bons*, or paper receivable in discharge of taxes. This third was called *La tiers provisoire*, but its price in the market continued very low until Bonaparte succeeded to power, and placed Gaudin, afterwards Duke of Gaeta, at the head of the treasury, when means were found to redeem the stocks from their depression, and to resume the payment of the dividends in cash. Could Bonaparte have obtained large sums on loan, his career of aggression and conquest would have been still more rapid; but, on the restoration of the Bourbons, in 1814, the public debt, funded and unfunded, did not exceed † L.123,000,000; its interest L.7,000,000. France had thus a fair prospect of financial prosperity, when the return of Bonaparte, and a second invasion by the allied troops, overthrew public credit, and produced a national loss, which, if to the very heavy contribution we add the general derangement of trade, greatly exceeded L.100,000,000 Sterling. Hence a long list of financial embarrassments; an oppressive addition to the taxes; delay of payment to the public creditor, and loans made at an interest of 8 and even 9 *per cent*.

Before the Revolution nearly half the revenue of France was raised, as in England, by taxes on consumption, viz. on salt, wine, brandy, tobacco, stamps, leather, and foreign goods, imported. All these were abrogated, in 1791, by the National Assembly, and replaced, by a property-tax (*foncier*), partly by the ruinous expedient of issuing assignats. This was done to establish the Revolution in the hearts of the people, who continued exempt from their old burdens above ten years, and so necessary was it to observe caution in recurring to these imposts, that it was not till 1803 and 1804, when the power of Bonaparte was fully consolidated, that taxes on consumption were renewed. The amount of the revenue was greatly impaired by this long exemption, and by the general confusion of the Revolution. In 1799, the expenditure ‡ exceeded the receipt by L.8,000,000 Sterling. The continental peace, a partial reduction of expenditure and improvements in the collection of the taxes, brought, in 1803, the receipts to L.19,500,000, while the expenditure was L.20,000,000. In subsequent years, both received a progressive augmentation, and, in 1813, the revenue derived from France, exclusive of conquered territory, was about L.27,000,000. Such also was its amount on the occurrence of the disasters of 1815, when the sums raised by public loan proving insufficient, it became indispensable to impose additional taxes. These carried the revenue, in 1818, to nearly L.35,000,000, but as they are already (1820) relinquished in part, and a promise given by government to relinquish more, we proceed to state the revenue of France in that form, which, after the expected modification, is likely to be permanent.

Foncier, or tax on real property, viz. the lands and houses of the kingdom at large. This tax, at the present very high assessment, yields L.10,000,000, but is likely to be progressively reduced to . .	L. 8,000,000
Mobilier, or tax on houses, with reference to the furniture and other effects of the tenant, . . .	1,300,000
Window-tax, ...	600,000
Patentes, or tax payable by persons exercising trades and professions,	600,000
The above form the *direct* taxes.	
Enregistrement, domaine et timbre. These comprise the stamp-duties, and a very heavy tax on sales, legacies, &c. amounting, in the whole, to	6,000,000
Sale of wood from the forests belonging to Government, average	800,000
Customs, ...	2,000,000
Salt tax, ...	1,600,000
Droits réunis, or indirect taxes, being an extensive combination of the excise duties on wine, spirits, beer, &c.	5,000,000
Tobacco and snuff (monopoly of the manufacture), ...	1,500,000
Lottery, ...	300,000
Post Office, ...	600,000
Newspapers, stamps, licences for theatres, &c. gaming-houses, .	220,000
All other receipts and contingencies,	1,480,000
Total,	L.30,000,000

The octrois and other charges borne by towns and country districts, without appearing in the budget, amount to L.1,500,000; and if to these be added the charge of collecting, the aggregate of

* *Report of* Camus *to the National Assembly*, in September 1790.
† Bignon, *Exposé comparatif de la France*.
‡ Gaudin, *Notice historique des Finances de la France*.

Revenue and Expenditure.

taxation in France will be found to be L.35,000,000, equal, after allowing for the difference of money, to nearly L.47,000,000 in England. Though this is greatly below the amount (see article ENGLAND, p. 149) levied in Britain and Ireland, the taxation of France is, in some respects, more injurious to productive labour. The *droit de patente* is a direct charge on industry, while luxuries, such as carriages, horses, men-servants, are exempt from imposts of any kind. In the assessment of the great tax, *the foncier*, there exists a surprising number of over-ratings on the one hand and omissions on the other, which are receiving a tardy remedy by the progress of the *Cadastre*. Finally, the *enregistrement* exceeds in pressure all our stamp taxes; being a duty on sales to the extent of five *per cent.* on the principal, a charge which, in very many cases, delays and even prevents the transfer of property.

The expence of collecting taxes in France is (Speech of M. Ganilh in 1818) fully 9 *per cent.* on the principal, or 3 *per cent.* higher than in England; but a more remarkable discrepancy, in the eye of the political economist, is, that while with us two-thirds of the amount are imposed on consumption, in France two-thirds are raised from production. M. Ganilh proposed, in 1814, to approximate to the English plan, by lessening the *foncier*, and other direct taxes, and by increasing the *droits réunis*, or Excise duties; but to innovate in taxation is a matter of great difficulty in France.

Expenditure.

The subjoined table contains the expenditure of France, after the discharge (in 1820) of all her engagements to the allied powers, and after funding her floating debt.

Interest of the national debt,	L. 8,000,000
Life annuities, - -	500,000
Interest of deposits made by public functionaries on entering on their places,	360,000
Annual appropriation to the sinking fund,	1,600,000
Pensions and half-pay allowances, civil and military, * - -	2,700,000
Clergy—stipends, pensions, and all allowances, - -	1,300,000
Civil list and princes of the blood,	1,300,000
House of Peers, chiefly in pensions for life, - -	80,000
House of Commons, for printing and other expences (no pensions), -	27,000
The annual votes to the different ministers are nearly as follows:	
Administration of justice throughout the kingdom, - -	700,000
Department of foreign affairs for office, charges, ambassadors, consuls, &c.	360,000
Carry over,	L. 16,227,000

Brought forward,	L. 16,227,000
Treasury-office charges and abatements of taxes, - -	850,000
Police, † - -	100,000
Army estimates, - -	6,000,000
Navy estimates, - -	1,800,000
Home department, comprising public works, and a variety of local expences, the funds for which, though raised on the spot, are held at the disposal of the minister of the home department, and re-issued on an application to him from the prefects or mayors,	2,500,000
Discount to collectors and others,	600,000
Add a computed amount for all extra or contingent charges, such as relief to the poor under a bad harvest, defalcation of particular taxes, &c. -	1,223,000
Total,	L. 30,000,000

Public Debt.

The French compute their public debt not by the principal, but by the interest payable—a preferable plan to ours, perhaps, since no government entertains a serious intention of paying off the principal; and to negotiate a loan is merely to make a sale of annuities, either for a term, or for perpetuity. Of the ten millions, payable annually to the public creditors before the Revolution, the half was in life annuities, the aggregate of stock, or borrowed capital, not amounting to 100 millions sterling. At present the case is different, the life annuities bearing, as in England, a small proportion to the rest of the debt. On the whole, the interest of the French debt is little more than a fourth of ours. Though their stocks yield an interest of 5 *per cent.*, paid, like ours, half yearly, their price has been low ever since 1813; L. 100 stock having been always purchasable for less than L. 80 in money, and frequently for L. 72, L. 70, L. 68, affording the buyer a return of 7 *per cent.* on his investment. The very minute subdivision of landed property in France is a great obstacle to the increase of capital. Still, the probabilities seem strongly in favour of a rise of French stock, by a progressive transfer of capital from countries, like England and Holland, where it yields only 4 or 5 *per cent.* Moreover, the sinking fund of France is now in an efficient state, receiving from the treasury an annual allowance of - L. 1,600,000

Sinking Fund.

Its farther supplies arise from the interest of the redeemed stock, sale of wood from the public forests, &c. -	500,000
Carrying its total income to -	L. 2,100,000

In regard to the annual budgets under Bonaparte, it is remarkable, that, while the *Exposés*, or general declarations, were replete with exaggeration and

* The part that is properly pensions, whether civil or military, cannot, since an act of 1817, exceed L. 920,000. They are, in general, very small, the whole L. 2,700,000 having been shared, in the year 1818, among 196,000 individuals, an average of less than L. 14 a-head.

† The expence of the police department was kept secret till 1810, when it was explained, and found, like other mysteries, to have been overrated.

National Income and Capital, &c.

falsehood, the arithmetical statements appended to them were fair and accurate—doubtless, on the calculation that the *Exposé* alone would engage the attention of the French public.

XII. National income and capital; population.

Cadastre.

Of the official surveys of the French territory, by far the most minute and accurate is the *Cadastre*, a survey which became indispensable, from the time it was determined to exchange the taxes on consumption for taxes on produce. A return of the rent of land, such as was made under the property-tax act in England, would not have answered, or indeed have been practicable in France, where so many thousand petty lots are cultivated by their proprietors. At first the Cadastre proceeded on the plan of an estimate *par masses de culture*, or continuous valuation of extensive tracts; but this proving unsatisfactory, it has been conducted, since 1807, on a plan of such minute detail, as to give the value of every separate *parcelle*, or patch of land. At present (1820) it is completed throughout one-third only of each department; and the inferences drawn from it, in regard to the kingdom at large, are as yet founded on the assumption, that the remainder is similar to the portion already surveyed. The annual expence of the survey is L. 120,000.

It is common to dwell on the advantages of France as situated in the centre of civilized nations, as raising within herself a great variety of products, and as capable of conducting her manufactures with comparatively few imports. Those, however, who have studied the subject thoroughly, will pronounce her real advantages to consist in a temperate climate, in a territory on the whole fertile, in a considerable extent of sea coast, and the possession of a military strength sufficient to protect her from aggression. As yet neither the capital or labour of the French have been judiciously directed; but the disposition to industry exists, and stands in need only of a judicious impulse.

France and Britain compared.

The taxation of France, computed by the individual, hardly exceeds L. 1, 11s. (English value) *per* head, while that of Britain and Ireland is not less than L. 3, 10s. *per* head. This, however, is a very inconclusive comparison, the question being not the relative number of the inhabitants, but the result of their productive industry. M. Chaptal computes (Vol. I. p. 225) the value of the land and farming capital of France at fifteen hundred millions Sterling, to which, making an addition for the difference of money, and a farther addition for the capital employed in manufacture and commerce, we arrive at an amount, not unlike the very large sum which Mr Colquhoun gives (see article England, p. 140) for the collective capital of Britain and Ireland. But we fix, by preference, the attention of our readers on the annual produce.

	Britain and Ireland.	France, after making an addition for the Difference of Money.
Gross produce of agriculture (see the preceding section on Agriculture), - - - - - -	L. 187,000,000	L. 270,000,000
Manufactures, including mines and minerals, -	100,000,000	76,000,000
Commerce, inland and foreign, - - -	70,000,000	40,000,000
	L. 357,000,000	L. 386,000,000

But the conclusive return, that which leads to a correct calculation of political strength, is the nett produce of the year.

	Britain and Ireland.	France, after making an addition for the Difference of Money.
Rent of land and farmer's profit, - - -	L.60,000,000	L.75,000,000
Rent of houses, - - - -	16,000,000	18,000,000
Taxable incomes, arising from commerce, manufactures, and professions, *i. e.* incomes of L.50 and upwards, -	30,000,000	not known, but probably not above 20,000,000
	L.106,000,000	L.113,000,000

The commercial calculation is taken from the property-tax return of 1810, deducting 25 *per cent.*, and making an addition for Ireland. Neither the income from the public funds, nor the wages of labour, are reckoned in either country.

The balance of income is thus less in favour of France than the balance of produce; and if we go a step farther, and ascertain the proportion of income disposable for public purposes, we shall find this the final and conclusive result, in our favour, because the number of persons to be supported out of our national income is far smaller than in France. The productive power of our country and people is, therefore, such as to make us capable of greater political exertions than our ancient rival, or any power in Europe What is it, then, which mars this fair

harvest, and casts a cloud over our prospects?—the magnitude of our taxation, and the enhancement of our provisions, consequent on that and on our corn laws. These are the causes of the emigration of annuitants, and others, in the middle ranks, and of the distress of so many of our countrymen of a humbler class, who remain at home. In France, the lower orders have never known much comfort; but, from the moderate price of provisions, they are put above distress, by wages which, to us, appear very low.

Price of Labour.

Those of the country labourer in France (Chaptal, Vol. I. p. 245) are only 1s. or 1s. 1d. a-day; of masons, 1s. 3d. and 1s. 4d.; of mechanics in towns, 1s. 6d., 1s. 8d., 1s. 10d., the whole without victuals, or any additional allowance. The wages of the women are a full third lower. *

Expence of Living.

The difference in the expence of living between France and our country is about a third; that is, L. 100 in France is equivalent to L. 130 or L. 140 in the southern, and to L. 120 or L. 130 in the northern part of our island. The difference, as far as regards provisions, is somewhat greater; but it receives a counterpoise in the cheapness of our fuel. The proportion now mentioned will be found applicable to the expence of the middle, as well as of the lower ranks. It will be found equally general in the sense of locality, being applicable to France and Britain at large, provided the parallel be made between towns or districts at a similar distance from either capital, Paris being as expensive compared to the rest of France, as London to the rest of England. Fortunately for us, the French have not paid much attention to the price, either of labour or fuel, in the places, such as Paris and Rouen, where they have established their rival manufactures. Another remarkable circumstance is, that various kinds of work, when performed by the piece, are nearly as dear in France as in England, so unaccustomed are our neighbours to simplify a task by the application of method, or the division of employment.

Population.

In the end of the seventeenth century, the territory of France, when equal, or very nearly equal to its present extent, appears, from the report of the intendants or provincial governors, to have contained about 20,000,000 of inhabitants. This number was found, by the census made by order of the National Assembly, to have increased nearly a third in the course of a century; the amount, in 1791, being 26,363,600, a number which, by the latest computation, made in 1817, had farther increased to above 29,000,000. These returns show, on the one hand, the exaggerated estimate commonly formed of the waste attendant on the wars of the Revolution; and, on the other hand, that the ratio of increase in France, though considerable, is (see article ENGLAND, p. 149) a good deal below that of our country. The average population of France is 144 inhabitants to the square mile.

Population of France, distinguished by Provinces and Departments.

Ancient Provinces.	Departments.	Population.
Flanders	North	899,890
Artois	Pas de Calais	580,457
Picardy	Somme	495,058
Normandy	Lower Seine	642,948
	Calvados	505,420
	Manche	583,429
	Orne	425,920
	Eure	421,581
Isle of France	Seine (containing Paris)	780,000
	Seine and Oise	439,972
	Oise	383,500
	Seine and Marne	304,068
	Aixne	442,989
Champagne	Marne	311,037
	Ardennes	275,792
	Aube	238,819
	Upper Marne	237,785
Lorraine	Meuse	284,703
	Moselle	385,949
	Meurthe	365,810
	Vosges	334,169
Alsace	Upper Rhine (reduced by the cessions in 1815 to)	318,577
	Lower Rhine (reduced by the cessions in 1815 to)	391,642
Brittany	Ille and Villaine	508,544
	Côtes du Nord	519,620
	Finisterra	452,895
	Morbihan	403,423
	Lower Loire	407,900
Maine	Mayenne	332,550
	Sarthe	410,380
Anjou	Maine and Loire	403,864
Touraine	Indre and Loire	275,292
The Orleannois	Loiret	286,153
	Eure and Loire	265,996
	Loire and Cher	212,552
Berry	Indre	204,721
	Cher	228,158
Nivernois	Nievre	241,520
Burgundy	Yonne	325,994
	Côte d'Or	354,436
	Saône and Loire	471,457
	Ain	304,668
Franche Comté	Upper Saône	300,156

* These returns apply not to Paris, but to provincial towns of ten, fifteen, or twenty thousand inhabitants. The want of canals causes a partial difference in the price of provisions, but in no degree to the extent asserted by those who (*Edinburgh Review*, No. 64, p. 362) adopt too readily the loose allegations so general in France. The cheapness of land carriage would speedily counteract it.

Population.

Ancient Provinces.	Departments.	Population.
Franche Comté	Doubs	240,792
	Jura	292,882
Poitou	Vendée	268,686
	Two Sevres	254,105
	Vienne	253,048
La Marche	Creuse	226,224
	Upper Vienne	243,195
Limousin	Correze	254,271
Bourbonnois	Allier	260,266
Saintonge and Angoumois	Charente	326,985
Aunis and Saintonge	Lower Charente	293,011
Auvergne	Puy de Dome	548,834
	Cantal	251,436
Lyonnois	Rhone	347,381
	Loire	315,858
Dauphiny	Isere	471,660
	Upper Alps	121,771
	Drame	253,372
Guienne	Dordogne	424,113
	Gironde	514,562
	Lot and Garonne	326,150
	Lot	268,150
	Tarn and Garonne	238,722
	Aveyron	331,373
	Gers	286,493
	Landes	235,550
	Upper Pyrenees	198,763
Bearn	Lower Pyrenees	383,502
County of Foix	Arriege	222,936
Roussillon	Eastern Pyrenees	126,625
Languedoc	Upper Garonne	367,550
	Aude	240,993
	Tarn	295,885
	Herault	301,099
	Gard	322,144
	Lozere	143,347
	Upper Loire	268,202
	Ardeche	290,833
Provence	Lower Alps	146,994
	Mouths of the Rhone	293,935
	Var	283,296
County of Venaissin	Vaucluse	205,832
	Corsica	174702,

As the departments of France do not differ much in superficial extent, a cursory inspection of such a list as that in the *Encyclopædia* discloses at once the different degrees of density in the population of the kingdom, exhibiting very clearly the superiority of Flanders and Normandy over the heaths of Poitou and the mountains of Languedoc. The temporary additions to the population of the French empire, made by the incorporation of conquered territory, amounted, in 1801, to 6,000,000, and, in 1811, the time of their greatest extent, to 14,000,000.

The estimates of population in France, subsequent to 1791, are formed, not like our population returns, on an actual survey, but by adding for the period that has intervened, the births, and deducting the deaths, of both of which an accurate record is kept in the public offices. It is thus difficult to compute the relative number engaged in different occupations; a late publication (by Count de Laborde) contains the following estimate;

	Persons.
In agriculture,	17,500,000
In manufacture,	6,200,000
Indigent,	800,000
Various employments,	4,500,000
Total,	29,000,000

Large as is this proportion of agriculturists, it does not exceed, nor indeed equal, the proportion returned in the official census of 1791.

	Population of the principal Towns.		Population of the principal Towns.
Paris,	713,000	Nancy,	29,000
Marseilles,	102,000	Rennes,	29,000
Lyons,	101,000	Besançon,	28,000
Bordeaux,	92,000	Troyes,	27,000
Rouen,	81,000	Aix,	27,000
Nantes,	75,000	Dunkirk,	26,000
Lille,	60,000	Versailles,	26,000
Strasburg,	50,000	Brest,	24,000
Toulouse,	48,000	Montauban,	24,000
Metz,	41,000	Avignon,	23,000
Nismes,	39,000	L'Orient,	22,000
Amiens,	39,000	Tours,	22,000
Caen,	36,000	Grenoble,	21,000
Montpelier,	32,000	Poitiers,	21,000
Clermont in Auvergne,	30,000	Limoges,	21,000
		Havre de Grace,	21,000
Rheims,	30,000	St Omer,	20,000
Toulon,	29,000	Dieppe,	20,000
Angers,	29,000		

That the proportion of our population inhabiting towns is greater than in France, is at once ascertained by taking the aggregate of twenty of the largest cities in each; for France, that aggregate is about 1,700,000; for Britain and Ireland, 2,300,000.

The *ratio* of the increase of population in France is greatest in the lower classes; the middling and upper ranks have seldom large families. Men in such stations in France are much less habituated to steady industry than in England; the openings in trade to respectable employment and eventual competency are comparatively few; and, in very many situations, the incomes are adequate to the support of an individual only. In that country, as with us, the population evidently increases faster since the adoption of vaccine inoculation. The illegitimate births are numerous only in Paris. Of the average mortality in France, there have not as yet been published returns of a comprehensive nature. The climate and soil are, in general, no less salubrious

Government. than those of Britain, and the advantages attendant on agricultural habits are enjoyed by a much greater proportion of the population; but a considerable waste of health, and even of life, takes place from the crowded nature of the towns, and the damp position of very many of the cottages. A want of comfort on the part of the lower orders, tends, along with their deficient cleanliness, to the same result; but, on the other hand, the general activity, temperance, and cheerfulness of the people, are all in favour of health and longevity.

XIII. Government.

France, before the Revolution, was much less of an integral body than England, its component parts having been united at a much later date, and each preserving a number of privileges which embarrassed and retarded the action of government. The countries called *Pays d'Etat* were governed by their own assemblies; taxation was different in different provinces; each clung with pertinacity to the preservation of transmitted usages; and nothing but a general convulsion could have broken down barriers supported by such a mass of separate prejudices and interests. It would be superfluous to enlarge on the different constitutions that followed each other so rapidly during the Revolution,—whether that of 1791, the work of a liberal but inexperienced Assembly; that of 1793, the work of the Jacobins; or the very different one of 1795, perverted first by the Directory, and finally overturned by the usurpation of Bonaparte. There is a brief sketch of each in the article France, in the *Encyclopædia ;* and as they have long ceased to interest the public, we proceed at once to the present constitution founded on the *Charter* granted on the return of the King in May 1814. That charter is appealed to by all parties as the safeguard of the French constitution, and is in substance as follows:

Substance of the Charter.

All ranks are equally admissible to public employments, whether civil or military. (The object of this clause is to do away any claim for preference on the part of the *noblesse.*)

The Catholic is the state religion, but all other religions may be openly professed, and none imply political disqualification.

All sales of national property during the Revolution are confirmed to the purchasers.

The person of the King is inviolable; the responsibility rests with his Ministers.

The executive power is vested in the King; the legislative, in the two Houses of Parliament as in England, with the distinction, that no bill can be brought in but by a Minister of the Crown, Parliament having the right only of praying the King to bring in any particular bill. (This restriction serves to prevent motions which might produce agitation in a country still very divided, and new to the discussions of a representative body.)

The House of Peers cannot be lawfully assembled except at the same time as the House of Commons.

The members of the Commons House are elected for five years, the house being renewable by a fifth annually. No one can be a member of this house unless of the age of forty or upwards, and unless he pays direct taxes to the amount of L. 40 a-year. Government

The sitings of the House of Commons are open to the public; those of the Peers are private; all money bills must originate with the Commons.

The judges are named by the King; and, when appointed, are not removeable. Juries are employed in criminal cases only.

House of Peers.

The House of Peers in France is, in many respects, on the same footing as in England, their number being unlimited; their nomination vested in the crown; their dignity hereditary. Like our Peers they meet every session on the same day as the Commons; and their proceedings, unless accompanied by simultaneous proceedings of the lower house, would be void. Like our Peers also, they take cognizance of charges of treason and of high political misdemeanours; but they do not form a court of judicial appeal. All bills, with the exception of money bills, may originate in either house; but the degree of public interest, excited by the debates of the Peers, is not so great as by those of the lower house. The restrictions as to attending the debates, and printing the speeches of the Peers, though not absolute, are greater than in England.

The King's brothers and nephews, with the princes of the blood (Orleans, Bourbon, Condé), are Peers in right of their birth.

The number of Peers in France is at present (1820) nearly 280, a number comprising two very distinct classes, the old nobility of France, stripped of the greater part of their paternal estates, but dignified by such names as Montmorency, Tremouille, Luxembourg; and the senators or generals of the Revolution, who can boast of no ancestry; and who, in point of property, are, in general, very limited, but who lay claim to public regard for their personal exertions; such are Lanjuinais, Pastoret, Bartholemy, Macdonald. Those who were members of the senate, on the abdication of Bonaparte, were made Peers, and had their life pension (L. 1500 a-year) confirmed to them by Louis XVIII.; but the constitution requires that all future peers shall posses a certain entailed property, the amount of which, evidently adapted to the levelling effects of the Revolution, is only L. 1250 of clear income for a duke, L. 800 for a marquis or earl; and L. 400 for a viscount or baron.

Chamber of Deputies or House of Commons.

The French House of Commons is, in many respects, similar to the British; each being the arena in which political parties try their strength, and in which the support or the overthrow of a ministry is decided. The nature of the subjects discussed, the privileges of the house, the admission of the public to the debates, are all similar to our usages; but there are some important differences as to the legal qualifications of the members, and the constitution of the body. No one is capable of being elected a representative of the commons till he is forty years of age. The number of deputies or members is regulat-

Government. ed by the amount of population. This, however, has nothing in common with universal suffrage, for the basis of the qualification of a voter is property; it being an indispensable requisite that every voter shall pay L. 12 a-year in direct taxes. This sum seems a very proper medium. From the nature of French taxation, it comprises a vast number of petty proprietors worth from L. 60 to L. 100 or L. 150 a-year. In like manner, the payment of L. 40, the qualification for a member, implies only the possession of L. 200 or L. 300 a-year.

The right of voting for Members of Parliament in France was long exercised by delegation, the voters choosing a committee (*college electoral*) composed of persons paying L. 40 in taxes, with whom rested the choice and nomination of the member; but this cold and indirect course was abrogated by the law of 5th February 1817; since which the voters have made a direct nomination of their members as in England. In this manner took place the two elections (each of a fifth of the house) in 1817 and 1818. The predilection shown in them to the *liberaux*, or moderate revolutionists, excited the fears of the royalists; but the King resisted all attempts to modify the established law, until a third trial in 1819, which, by giving another powerful addition to the *liberaux*, induced both him and his counsellors to project a change. This change is now (May 1820) in its progress through the House, and bids fair to be temperately conducted; the present number of members (258) being evidently too small for so great a country, it is proposed to extend them to 430, and to confine the election of the additional number (172) to electoral committees on the old plan. Another part of the proposed change is to dispense with annual elections, and to declare the whole House of Commons entitled to sit for five years as it is in England for seven.

The new law proposes no change in the qualification of voters. The number of the latter is of course very different in different departments; the medium is from 1500 to 2500, but in the department of Paris they exceed 10,000. In the cities, the majority of the voters are *patentés*, that is, they derive the property entitling them to vote from mercantile business; but in the small towns, and still more in rural districts, the great majority consist of *petits propriétaires*. Family influence is of very little account in France; voters, when so numerous and independent, are actuated, as in our popular elections, by motives of more comprehensive operation, such as the public character of the candidate, or a sense of the national wants at the time. The King is bound to convoke the chamber annually; he has, as in England, unlimited power to prorogue or dissolve; but in that case, a new chamber must be called in the course of three months.

The members of the French parliament are now only beginning to reap the benefit of influence; the distribution of patronage not being as yet reduced to a system. The same observation applies to parliamentary tactics; for, though the parties are marked by a very distinct line, their votes are not to be anticipated with so much certainty as in St Stephen's Chapel. The usage, in the French Parliament, is to read a speech; and, if at all remarkable, it is soon after printed at full length. Many of these afford tolerable specimens of Parliamentary eloquence, but prepared less with a view to a practical result than to attract attention to the speaker, and to give him *son jour de renommée, son heure de gloire*.

Executive Branch. Conseil des Ministres or Cabinet.

The cabinet consists properly of eight members; the President, or *premier*; the Keeper of the seals, or Chancellor; the Master of the Royal Household, and the five Secretaries of State. When, as generally happens, the *premier* is also one of the secretaries of state, the number of the cabinet is seven. The secretaryships are, as in England, the foreign affairs, the war department, the home department; the treasury, and, finally, the navy; to which are joined the colonies. The functions are so similar to those of the corresponding offices in our own country, that the only branch requiring explanation to an English reader is the police, formerly a separate secretaryship, but blended, since January 1819, with the home department. Exclusive of the care of public tranquillity, and the detection of state offences, the police in France has the *surveillance* of the newspapers; the latter being subject, before printing, to inspection and alteration by government agents. This unpopular restriction, after being removed in 1819, has been reimposed by an act of the present year (1820), founded on the danger of unreserved discussion during the present animosity of parties.

Conseil Privé.

The privy council in France, as in England, assembles only occasionally by order of the King, and for the dispatch of special business. It is composed of the members of the cabinet, and of a more numerous body of public men styled *Ministres d'Etat*, a title implying not that the persons who bear it are actually in office, but of such reputation, either in a civil or military capacity, as to have merited at the hands of the King this high honour, and the pension which accompanies it; their number at present is about thirty, almost all peers; the aggregate of the pensions L. 10,000 a year.

Ministres d'Etat.

Conseil d'Etat.

The *conseillers d'état* and *maitres des requêtes* are two classes of men of limited property but good education, who have devoted themselves to government business as a profession or occupation for life. The persons who bear these designations, without duty or salary, amount to several hundreds, but there are regularly *en activité de service* 30 *Conseillers d'Etat* and 40 *maitres des requêtes*. They form five permanent committees, each acting under the direction of a minister. Thus, the committee of the home department prepares bills to be submitted to Parliament, or regulations to be adopted in regard to various matters belonging to that ministry; the committees for finance, for legislation, and for the navy, discharge a correspondent duty each in its respective department; while a committee of a more ambiguous title, "*du contentieux*," takes cognizance of misunderstandings and disputes between the public and the different administrative bodies throughout the kingdom.

Cour des Comptes.

The *Cour des Comptes* is a very extensive esta-

Government. blishment, which may be termed a board of general audit; its functions consisting in examining the accounts of the treasury, of the receivers-general, of the paymasters-general, and of the civil list. The members of this board form two classes; the *conseillers référendaires*, by far the more numerous, who go through the process of examination, and the *conseillers maitres*, who sit in three chambers, each of five or six members, and decide on the reports of the *référendaires*.

Maison du Roi. The royal household, like other public departments in France, exhibits a long list of high sounding appellations; here are a *grand aumonier, grand chambellan, grand ecuyer, grand maitre des cérémonies, grand maitre de la garde robe*, followed by the *intendant du trésor; intendant des forêts; intendant des menus plaisirs du Roi*, &c. Establishments, also on a large scale, are appropriated to the princes, the whole attended with a very considerable expence, and evincing, on the part of the court, an unconsciousness that the Revolution has dispelled some ancient illusions, and that the attachment of the more valuable part of the French nation is to be acquired by other means than the display of pageantry.

Provincial administration. The plan of provincial administration is uniform throughout all France. Each department has at its head a *Prefet* or civil officer, who acts as the medium between it and government, maintaining a daily correspondence with Paris, receiving the orders of the minister of the home department, and reporting from time to time on their execution, as well as on all local transactions of interest; whether relating to the collection of taxes, the levy of recruits, the expenditure for roads, or the state of political feeling. The only similar office in England is that of lord-lieutenant; but the duties of a *prefet* are much more laborious. Another material distinction is that the latter, for the sake, doubtless, of securing his impartiality, is never almost appointed to a department in which he has property or family connections. Each prefet is aided by a *Conseil de Prefecture*, consisting of three, four, or five members, whose duty consists in taking the detail of business off his hands. The departemental council (*Conseil General de Departement*) is much more numerous, comprising sixteen, eighteen, twenty, or more members; but they meet only a few weeks in the year, nor are they of much use, except to share, as a collective body, the responsibility attendant on the distribution of taxes, or other similar measures.

Sous Prefet. A *Sous Prefet* is an officer much inferior to the prefet. There is one to each of the districts called *Arrondissement*, and he is aided in his labours by a council, unnecessarily numerous, of eleven members.

Communes. Lastly come the *communes*, the smallest of the official divisions of the French territory, and of which there are above 38,000 in the kingdom. The country *communes* are little else than parishes; but the distinguishing characteristic of a *commune* consists in having, not a church and clergyman, but a mayor and municipal council. A city, however populous, as Lyons, Marseilles, Bordeaux, forms only one *commune*; and, on the other hand, when, as very often happens, the population of a *commune* is at or below 2000, it has still its mayor and council. The mayors, however, have salaries only in the large towns, where their occupations are considerable; comprising the management of the town funds, whether arising from dividends, rents, or octrois, and the disbursement for all public works. The property in land and houses belonging formerly to the towns was, in many cases, lost in the Revolution. Administration of Justice.

It was formerly the practice to transact a great share of government business in the country towns; but, since 1800, Paris has been rendered as much the general centre and resort in that respect as London,—an effectual means of eluding the old and peculiar usages of the provinces, and of producing uniformity in the execution of the laws, but attended with a surprising accumulation of *employes* in the government offices of the capital.

The salaries are as follows: Minister, L. 4000; Under Secretary of State, L.1600; *Conseiller d'Etat*, L. 650; *Maitre des Requêtes*, L.250; Prefet (varies, but on an average), L. 1500 a-year; a *Sous Prefet*, between L. 200 and L. 300. Salaries.

The most comprehensive, though the least ancient, order, is that of the *Legion d'Honneur*; an order instituted by Bonaparte, and maintained on nearly the same plan by the Bourbons. The usual title to admission is the discharge of functions, either civil or military, with distinction; and, in time of war, the performance of an action of *eclat*. The gradations are, *chevaliers*, of whom the number is unlimited, and very great; *officers*, who amount to no less than 2000; *commanders*, to the number of 400; *grand officers*, 160; and *grand croix*, to the number of 80. A member must serve several years as a chevalier before becoming an officer, and the same progressively through the other ranks. Admissions take place once, and frequently twice a-year; a specific number being allotted to each great department of the public service, the military, the judicial, and the administrative. Orders.

The other orders are, that of St Louis, which is strictly military; that of St Michel, which dates from 1469, is limited to 100 members, and is conferred as a recompense for distinction in science, literature, or the arts. Eminent professional men and artists, and the authors of discoveries of public utility, constitute the members of this order. The order *du St Esprit*, created in 1578, and of the very highest rank, comprises princes of the blood, prelates, and members of the order of *St Michel*—the whole limited to the number of 100.

XIV. Law, and administration of Justice.

In this great department, France shows nothing of the backwardness apparent in her situation in many other respects, but is entitled to the particular attention of other nations, and of none more than our own. Law does not rest on tradition, nor is it necessary to study it in a never ending accumulation of decisions. It is reduced into a compact and definite form, the result of a code formed recently, and with all the benefit of the application of the knowledge of an enlightened age to the principles of

Administration of Justice.

jurisprudence. Nothing could be more irregular than the administration of justice in France before the Revolution. The first stage of a process took place before judges appointed not by the King but by the *Seigneur*, or lord of the district. These judges had power to impose a fine, to decree a short imprisonment, or other correctional punishment, and to give, in a civil suit, a decision subject to appeal. The *Senechals* and *Baillis* ranked a degree higher, and were entitled to give a verdict in cases of importance, subject, however, to an appeal to one or other of the Parliaments, of which there were, in all, thirteen in France; and which, very different from the Parliaments with which we are familiar, were composed of judges and public officers of rank. The whole of this inharmonious mass was reduced into a simple and uniform system by the National Assembly, in 1791; the seignoral judges being replaced by justices of the peace, and every district of importance (*arrondissement*) obtaining its court or *tribunal de première instance*. The higher courts were not added till afterwards, but the judges of every description were elected by the inhabitants of the province—a right which continued with them until the usurpation of Bonaparte.

Different Codes.

But there remained for the National Assembly another and a much more laborious work. Each province had its peculiar code, some founded on the Roman law, others on tradition and local custom, but the whole replete with ambiguity and discrepancy. To digest a complete body of law that might suffice for the country at large, and supersede the provincial codes, was the labour of many years, and of a number of eminent lawyers. It was not completed until the beginning of the present century, when it was promulgated under Bonaparte, and gave to the jurisprudence and judicial constitution of France nearly the form they at present bear. This body of law consists of five codes, entitled respectively, 1. *Code civil; 2. Code de procédure civile; 3. Code de commerce; 4. Code d'instruction criminelle; 5. Code penal.*

The *Code Civil*, the first and by far the most comprehensive of these divisions, defines the rights of persons in their various capacities of citizens, parents, sons, daughters, guardians, minors, married, unmarried. It next treats of property in its respective modes of acquisition and possession, as inheritances, marriage portions, sales, leases, loans, bonds, mortgages.

The *Code de Procedure Civile* prescribes the manner of proceeding before the different courts of justice, beginning with the *juge de paix;* also the mode of carrying into effect sentences, whether the payment of damages, the distraining of goods, or the imprisoning of the party condemned. It declares, likewise, the course to be followed in transactions distinct from those of the law courts; as in arbitration, taking possession of an inheritance, or a separation of property between man and wife.

The *Code de Commerce* begins by defining the duties of certain officers, or commercial agents, such as sworn brokers and appraisers; it next treats of partnerships—of sales and purchases—of bills of exchange—of shipping, freight, and insurance—of temporary suspensions of payment, and bankruptcies.

The *Code d'Instruction Criminelle*, a very different, but equally important division, explains the duties of all public officers connected with the judicial police, whether mayors, assistants of mayors (*adjoints*), *procureurs du roi, juges d'instruction*, &c. After prescribing the rules regarding evidence, it regulates the manner of appointing juries and the questions which fall within their competency. Its farther dispositions relate to the mode and nature of appeals, and to the very unpopular courts authorized to try state offences, termed *Cours Speciales* under Bonaparte, and *Cours Prevotales* under the Bourbons.

Lastly, the *Code Penal* describes the punishments awarded for offences in all the variety of gradation, from the penalties of the *police correctionelle*, to the severest sentence of the law. All offences are classed under two general heads,—state offences, such as counterfeiting coin, resisting police officers, sedition, rebellion; and offences against individuals, as calumny, false evidence, manslaughter, murder.

These codes,—the first attempt to reduce the laws of a great nation to the compass of a volume, consist of a number of sections and short paragraphs, each paragraph marked by a Number, as a means of reference. The style is as concise as is compatible with clearness. The arrangement is minute and elaborate. The whole is sold for a few shillings, in the shape of one octavo, or of two duodecimo volumes; and copies of it are in the possession, not only of all judges, pleaders, and attornies, but of agents, merchants, and persons in business generally, who, without being enabled by it to dispense with the aid of lawyers in a suit, find in it a variety of useful explanations, relative to questions of frequent occurrence in their respective occupations.

Administration of Justice.

The Justices of the Peace are very numerous, there being one for each canton, and consequently nearly 3000 in the kingdom. They never are, as in England, clergymen, and seldom country gentlemen, but persons acquainted with law, and in circumstances which make the salary, small as it is (from L. 30 to L.40), an acceptable return for a portion of their time. They are not unfrequently provincial attornies, or pleaders retired from business. The Justice of the Peace, or *juge de paix*, is authorized to pronounce finally in petty questions (under 50 franks, or L.2), and to give, in questions of somewhat greater amount (up to 100 franks, or L. 4) a decision subject to appeal. He takes cognizance, likewise, of disputes about tenant's repairs, servant's wages, and the displacing of the land-marks of property. No action can be brought before a court of justice in France until the plaintiff has summoned his adversary before a *juge de paix*, with an amicable intent (*cité en conciliation*), and received from the *juge* a *procés verbal*, showing that the difference could not be adjusted. When the justice is prevented from acting, his place is taken by his first, and, if necessary, by his second substitute.

Juge de Paix.

Administration of Justice.

Tribunaux de première instance.

Of the *Primary Courts,* there is one for every *arrondissement*, making above 360 for the whole of France. Each is composed of three or four members, of two or three *suppléans* or assistant members, and of a *procureur du roi*, acting on the part of the crown. In populous districts, *cours de première instance* comprise six, seven, eight, or more members, and are divided into two or three chambers. They are chiefly occupied with questions of civil law, and hold, in the extent of their jurisdiction, a medium between the humble limits of the *juge de paix* and the wide powers of the *cour royale;* their decisions being final wherever the income from a property does not exceed forty shillings, or the principal forty pounds; but subject, in greater matters, to an appeal to the *cour royale*. The members of these inferior courts are named, like other judges, by the crown, and hold their places for life; the salary of each is only L. 80 a-year, equal to L. 120 in England; their number, throughout all France, including *suppléans,* is not far short of 3000.

A section of the *Tribunal de première instance* is appropriated to the trial of offences under the name of *tribunal de police correctionnelle;* and here the English reader must be careful to distinguish between judicial and government police; the former having no reference to state offences, such as libel or treason, but comprising a very numerous list of another kind, viz. all offences that do not amount to crimes, or subject the offender to a punishment *afflictif ou infamant*. These offences, when slight, are called *contraventions de police,* and are brought before a *juge de paix*, or the mayor of the *commune;* when of a graver stamp, and requiring a punishment exceeding five days imprisonment, or a fine of 15 franks, they are brought before the court now mentioned, whose sentences, in point of imprisonment, may extend to the term of five years. The trespasses brought before a justice of the peace or mayor are such as damaging standing corn, driving incautiously in the high way, endangering a neighbour's property by neglecting repairs. The offences referred to the *tribunal correctionnel* are such as assault and battery, swindling, privately stealing, using false weights or measures, &c.

Cours Royales.

We now come to the higher courts of justice, which equal in jurisdiction our courts in Westminster Hall, and on the circuit, but with the material distinction, that in France the civil courts are always stationary. The *Cours Royales,* in number 27, are attached to the chief provincial towns throughout the kingdom. They are all formed on the same model, and possessed of equal power, though differing materially in extent of business and number of members. The number of the latter depends on the population of the tract of country (generally three departments), subject to the jurisdiction of the court. In a populous quarter, like Normandy, a *Cour Royale* comprises 20, 25, or even 30 judges, and is divided into three or four chambers, of which one performs the duty of an English Grand Jury, in deciding on the bills of indictment (*mises en accusation*); another is for the trial of offences (*police correctionnelle*); and a third, with perhaps a fourth, is for civil suits. These courts are often called *Cours d'Appel*, as all the cases that come before them must previously have been tried by an inferior court. The collective number of judges in these higher courts is not short of 900; an aggregate hardly credible to an English reader, and which would prove a very serious charge on the public purse, were not their salaries very moderate, viz. from L. 100 to L. 300 a-year, according to the population of the towns where the court is held. In the financial pressure of 1816 and 1817, a reduction of this numerous body was much called for; but no diminution was made in the number of the courts, whatever gradual decrease may be allowed to take place in the members from decease or retirement.

Paris does not, like London and Edinburgh, absorb almost all the civil business of the country. It has, it is true, a *Cour Royale* on a large scale (five chambers and 50 judges), but confined in its jurisdiction to the metropolis, and the seven adjacent departments. There is a *procureur du roi* for every *tribunal de première instance*, and a *procureur general* for every *Cour d'Appel.*

Assize Courts.

The Assize Courts take cognizance exclusively of criminal cases; that is, of the crimes or serious offences referred to them by the *cours royales.* They consist of three, four, or five judges, members of the *cours royales,* but never belonging to the section that finds the indictments. The grand accompaniment of a French Assize Court is a Jury, which, as in England, consists of twelve members, and decides on the facts of the case, leaving the application of the law to the judges. Complete unanimity was at no time necessary in a French jury. At first a majority of ten to two was required; but this was subsequently altered to a simple majority, with the qualification, that, in case of condemnation by only two voices (seven to five), the verdict should be re-considered by the judges and the party acquitted, if, on taking judges and jurymen collectively, there was a majority in his favour. The assizes are the only courts in France that are not stationary. They are, however, generally held in the chief town of a department once in three months. The costs of suit are very exactly defined by a printed *tarif;* and it is a rule in criminal as in civil cases, that the party condemned is liable for all.

Cours Spéciales, Cours Prévotales.

The *Special Courts* were constituted out of the usual course for the trial of state offences. The *Cours Spéciales* were appointed by Bonaparte, the *Prévotales* by the present government, during the period of political effervescence (fortunately short lived) which succeeded the second entry of the king, and the misfortunes brought on the nation by Bonaparte's return from Elba. In both cases, the courts were considered as under the influence of government, and were, of course, obnoxious to the enlightened part of the public.

Tribunaux de Commerce.

The name of *Tribunal*, or Court, is given in France to a committee of five merchants, or leading tradesmen, appointed by the mercantile body in every town of considerable business or population. Their competency extends to all disputes occurring in mercantile business, and falling within the provisions of the *Code de Commerce.* Their decisions are founded on that code, and on the customs of merchants.

Administration of Justice.

They are final in all cases below L. 40. The presence of three members is necessary to form a court: The duty is performed gratuitously, and the number of these courts in France is about 160.

Cour de Cassation.

The *Court of Cassation*, the highest in the kingdom, is held at Paris, and is composed of three chambers, each of sixteen members and a president, making, with the *premier president*, a total of 52. Its province is to decide definitively in all appeals from the decrees of the *Cours Royales;* investigating not the facts of a case, but the forms of law, and ordering, wherever these have been infringed or deviated from, a new trial before another *Cour Royale*. This revision takes place in criminal as well as in civil cases. The royal court chosen for the new trial is generally, for the convenience of the parties, the nearest in situation to the other. The *Cour de Cassation* has farther powers, and of the highest kind. It determines all differences as to jurisdiction between one court and another; and exercises a control over every court in the kingdom. It has power to call the judges to account before the minister of justice, and even to suspend them from their functions; acting thus as a high tribunal for the maintenance of the established order of judicature.

Ministry of Justice.

The minister bearing the title of "Keeper of the Seals and Minister of Justice," may be compared to the Chancellor of England, though his patronage is much less extensive, and his functions much more suitable to the station of minister. He rarely acts as a judge, but exercises a general superintendence over the judicial body. He is the medium between the king and the courts of justice, in the same way as the minister of the home department is in regard to the civil authorities. The expences of the judicial body fall under his cognizance. The *procureurs généraux* and *procureurs du roi* throughout the kingdom address their correspondence to him, and it is his province to report to the king on the alleviation of punishment; on pardons; in short, on all disputed points, whether of legislation or administration.

Juries.

Juries were introduced into France in 1791, and confined from the beginning to criminal trials; nor does there seem any wish to extend their jurisdiction to civil suits. During several years, there were in France grand juries constituted as in England; but under Bonaparte their functions were transferred to the *Cours Royales*, on the plea that none but judges could be made to understand the difference between bringing to trial and bringing to punishment; and that the consequence frequently was a discharge, when a true bill ought to have been found. It has, in fact, been questioned, whether the institution of juries is advisable in a nation, of which the mass is still strongly tinctured with the *credulity* engendered by blind submission to an absolute government. That the French can supply special jurymen of judgment and discrimination, must be admitted by all who know how eminent are many of their men of business; but by their common juries, the nature of evidence is as yet little understood; and considerable experience will be necessary to form to the habit of deliberate reflection individuals so much more open to impressions of feeling than of reasoning. Adroit pleaders have been known to obtain very unexpected acquittals; and it is remarkable, that all the charges against French juries turn on their bias to clemency; none on a leaning towards the prosecutor, whatever may be his wealth or rank. The very numerous party, called *Liberaux*, maintain, that practice only is wanting to qualify their countrymen to act on juries. They demand, therefore, the restoration of grand juries, and the exclusion of the executive power, from interference with the election of common juries, or with the appointment of *juges de paix*, mayors, or other local magistrates. These encroachments on popular rights all owe their origin to Bonaparte; but they are too convenient for the executive power to be readily relinquished by his successors.

Present State of Crime and Punishment.

One of the chief improvements made by the French National Assembly was of the nature which now engages the deliberation of our own Parliament—a general mitigation of the penal code, or rather the substitution of punishments likely to be enforced for others of such severity, as in general to put their application out of the question. Stealing privately in a dwelling-house was formerly punishable in France by the rack and death—an extreme which prevented respectable persons from bringing delinquents before a court, and tended, of course, to give frequency to the offence. Of the state of crime in France, and of the nature of the punishments, an idea may be formed from the following return made to the king by the minister of justice:

	In 1817.	In 1818.
Individuals tried,	14,146	9,722
Condemned,	9,431	6,712
Acquitted,	4,715	3,010
Of these the Crimes or Offences were,		
Against the state,	438	166
—— the person,	1,638	1,262
—— the property,	7,086	5,547
Sentences.		
Death,	558	324
Compulsory labour for life,	511	393
Transportation,	52	6
Compulsory labour for a term of months or years,	2,645	1,992
Compulsory labour, and to be branded,	172	184
Solitary confinement,	2,774	2,116
Pillory,	4	1
Banishment,	12	2
Degradation from the rank of citizen,	2	5
Imprisonment and fine,	*2,629	1,619

Has the new French code, it may be asked, fulfilled the public expectation; and has it enabled the courts of justice to dispense with a reference to the old unwieldy body of law? In general, it has; the

* The year 1817 was one of great distress among the lower orders, as well from want of work, as from the high price of provisions.

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exceptions arising from obscurity or deficiency in the provisions of the code, being as yet neither frequent nor important. But the old laws regulate all questions arising out of transactions passed, or out of rights acquired, *prior* to 1803 and 1804, the date of promulgating the code, as the latter has no retroactive operation. The law students in France thus regard the code as the sole authority. They, however, still read the more celebrated writers on law prior to the Revolution; but they do so for the sake of collateral illustration, in the same way as they study the Roman law.

There still exists in France the singular practice of parties engaged in a law-suit visiting the judges in private; a practice originating in an age when suitors thought a personal interview the only effectual mode of explaining their case, and continued in more enlightened times from that over complaisance which is the ground-work of several of the defects of the national character. Such interviews are little else than an exchange of compliments, nor have the judges, either before or since the Revolution, been charged with acting under the influence of such *ex parte* statements.

The salaries of French judges must appear insignificant to an English reader, but there are in that country a number of men of small patrimony but good education, who have no idea of trade or of active pursuits in private life, while they attach much importance to government employment; moreover, the functions of judges, and in general of public officers in France, engross much less time than in England.

The law style of the French is much more brief than ours; their deeds, such as leases, mortgages, sales, being generally contained in very few pages, and free from obscure or antiquated phraseology.

XV. Historical sketch of late events.

It remains to conclude this article by a rapid sketch of the most remarkable events that have occurred in France since the peace of Presburg in 1805, till which period the history is brought down in the *Encyclopædia*.

The peace of Presburg, concluded after the victory of Austerlitz, bore an appearance of moderation on the part of Bonaparte, which was soon contradicted by the proceedings of the ensuing year,—the conferring the title of King, with augmented territories, on the Elector of Bavaria and Duke of Wirtemberg; the change of government in Holland from the republican to the royal form, and giving
June 5,1806. the crown to Louis Bonaparte; but more from the
Aug. 6, — forced abdication of the imperial dignity by Austria, and the establishment of the French power in Germany by the Confederation of the Rhine. Bonaparte having taken occasion, in an address to the senate, to profess a disposition for peace with England, and a communication to that effect having been made by Talleyrand to Mr Fox, the result was a negotiation at Paris; conducted at first by Lord Yarmouth, and in its more advanced stage by Lord Lauderdale. At one time the French government evinced a considerable disposition to concede, offering to sanction our keeping both Malta and the Cape of Good Hope; but such offers were probably suggested by the hope of adding Sicily to their Italian acquisitions; and that they were not made in the spirit of peace was apparent from the conduct pursued at the time by Bonaparte towards Prussia. The treaty between that power and Russia, concluded shortly before the battle of Austerlitz, furnished him with grounds of complaint, and the negotiation that ensued was conducted on his part with the artful view of engaging Prussia in a war apparently by its own act. The Prussians, inflated by recollections of a past age, and emboldened by an affected dread on the part of Bonaparte, took the field, occupied an advanced position in Saxony, and allowed their calculating adversary to gain the flank and even the rear of their army; after which the loss of a battle could not fail to cut them off from Berlin, and lead to the surrender, one by one, of almost every corps in their army. Such was the result of the disastrous day of Jena; the capital was occupied, and fortresses, like Magdeburg and Custrin, which, if prepared, would have made a long resistance, were surrendered in a few weeks. The French now advanced into Poland, where, in the depth of winter, the first conflicts took place
between Bonaparte and the Russians,—and where, Dec. 26,
at Pultusk, Golymin, and still more at Eylau, 1806.
these rude antagonists taught him that audacity Feb. 8, 1807.
and celerity are not always crowned with success. At last, on the arrival of reinforcements, and on the season becoming more favourable for military movements, Bonaparte acquired a superiority,
defeated the Russians at Friedland, and following June 14, —
them with a great force, found means, partly by intrigue, partly by intimidation, to dispose the Emperor Alexander to a peace, concluded at Tilsit on 7th July. This treaty, while it restored to Prussia somewhat more than half of her territories, left her in the dependence of Bonaparte, who seeing himself master not only of France, the Netherlands, and Italy, but of the half of Germany, determined to carry into execution a long meditated project on
Spain. With this view he repaired to Bayonne, in- April 1808.
veigled the royal family into that town, extorted from them a surrender of their rights, and conferred on his brother Joseph a crown which he destined at no distant period for himself. This was a remarkable epoch in the career of Bonaparte;—the first in which he openly cast aside the veil, and allowed the world at large to obtain an undisguised view of his character and projects.

The Spaniards acted with unexpected courage; and taking up arms, succeeded in compelling
the surrender of a considerable corps of French July 20, —
under Dupont, and the evacuation of Madrid by the intruded monarch. All Europe, and no country more than France, exclaimed against this flagitious aggression. Of redeeming his character, by a return to equity, he seems never to have dreamt; but he discovered infinite activity and skill in amusing his subjects, deceiving foreign courts, and enforcing the execution of his projects by military combinations. He occupied the Parisians by fêtes, professed anew a disposition to peace, arranged with

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the Emperor of Russia an interview at Erfurth, drew closer the bonds of alliance with that monarch, and was thus enabled to remove a large portion of his armed force from Germany into Spain. When collected there, and in readiness to act, he left Paris, travelled rapidly to his army, scattered his ill-disciplined opponents, entered Madrid, and even tried to overtake our army under Sir John Moore; but found it expedient to return to Paris, and prepare the forces of France and her German allies to meet a threatened attack from Austria. This new war, begun in April 1809, took, from the date of the battle of Eckmuhl a favourable turn to the French, who marched forward to Vienna, and, though foiled with great loss in
May 21, 22. the dreadful battle of Aspern, reasserted their su-
July 6, — periority at Wagram, and compelled Austria to a
October 14. peace, accompanied by considerable cessions; but still deemed indicative of moderation on the part of Bonaparte, until subsequent events discovered, that the promised hand of a young princess had effected the preservation of some valuable provinces. The same summer witnessed the failure of our expedition to the Scheldt, and an unsuccessful attempt to drive the French from Madrid; so that the power of Bonaparte seemed to become more and more consolidated, and the annexation of Holland to
July 1810. France took place without opposition.

It remained now only to expel our troops from Portugal, a task committed to Massena, at the head of a veteran army, which crossed the frontier in September, and penetrated into the heart of the kingdom, but soon received a proof of the firmness of our battalions at Busaco. Superiority of force enabled the French to march forward, but the lesson they had received deterred their general from an attack on our lines at Torres Vedras; and Europe saw with surprise month after month passed in inaction by bands hitherto only accustomed to advance and conquer. At last, in the beginning of March (1811), the want of provisions compelled them to retreat to the Spanish frontier; and though the subsequent events of the campaign on the side of Badajoz, Albuera, Cadiz, and Ciudad Rodrigo, were of varied success, our troops maintained a high reputation, and the French made little progress in the subjugation of the peninsula.

The attention of the public was now attracted to a growing rupture between France and Russia; and Bonaparte appears to have been deterred only by the lapse of the summer months, from attempting, in 1811, that plan which was put into execution, with so preponderating a force, and such probabilities of success, in 1812. Secure of Austria by alliance, and master of Italy, Prussia, Saxony, Bavaria, and Wirtemberg, he directed against Russia a host which appeared irresistible, and which, in fact, could be opposed only by one course,—that of evacuating province after province, removing or destroying the magazines, and obliging the enemy to contend with all the physical disadvantages of a thinly peopled country. Such, accordingly, was the policy of the Russians. The battle of Borodino,
Sept. 7, 1812. hazarded without much advantage of position, seemed a momentary departure from their cautious course; but it was soon resumed, their army retiring to the south of Moscow, avoiding farther fighting, and annoying their opponents chiefly by the destruction of supplies. Bonaparte, always sanguine, delayed commencing his retreat until the 20th October, and had not proceeded above a fortnight on his march, when the inclemency of the season, and deficiency of provisions, began to prove fatal, first to his horses and soon after to his soldiers. Such was the situation of the French, with a march of more than 400 miles before them. The Russians and Cossacks, without venturing on close action, found means to annoy them exceedingly; and, by a rare coincidence, a Russian army advancing northward from Turkey, was enabled to reach the line of retreat of the French. The latter, reinforced by fresh troops, were still able to force their way, but the intensity of the cold, and the continued deficiency of provisions, led to an increasing and rapid reduction of their numbers. Their total loss, from the beginning to the end of this campaign, amounted to 300,000 men; a calamity which encouraged Prussia at once to throw off the yoke, and Austria to prepare the means of taking a less eager but more decisive part in the contest.

In France the extent of the catastrophe was concealed; but even had it been known, the power of Bonaparte was too firmly fixed to be shaken by popular murmurs. The whole frame of administration, from the senate to the municipal councils, was devoted to him, and a levy of 350,000 men was forthwith ordered. With part of these, Jan. 11,
and with a part also of his remaining veterans, 1813.
he again took the field in Germany, met the advancing Russians and Prussians, and gained, at Lutzen on the 2d, and at Bautzen on 21st May, successes, which, without equalling the victories of his better days, taught his opponents the necessity of caution, and disposed them to a more cordial co-operation. After an armistice from June to August, passed, however, in the most active preparations, operations recommenced, and the French were evidently overmatched in force. On one occasion they foiled at Dresden, by a prompt concentration, a bold attempt of the allies; but in every other direction, whether in Silesia, in Lusatia, or, subsequently, in the heart of Saxony, they felt their inferiority to their more numerous opponents. Finally, the battle of
Leipsic decided the independence of Germany, and Oct. 18.
the retreat of the French to the Rhine. On the side of Spain similar disasters had been experienced; the force hostile to France was then under the direction of a single leader, and triumphed in repeated actions, first at Vittoria, on 21st June, and afterwards near Pampeluna, in the end of July; advancing, in the end of the campaign, to the frontier of France.

Such was the situation of affairs in the beginning of 1814. Bonaparte seemed at last to lower his tone, sending back Ferdinand to Spain, making a pacific overture to the allies, and attempting to awaken the sympathy of his French subjects. New taxes and new levies were ordered by his subservient senate; but the time to discipline the latter was not given him by his opponents. The campaign opened with the invasion of France, in the southwest, by the British, and a far more extensive inva-

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sion on the north-east by the Russians, Austrians, and Prussians. Our troops, acting in concert, and on a matured plan, met with no reverse of fortune. Our allies, less cautious, obtained, at first, some successes, but were taught at Montmiril and Montereau that Bonaparte, if reduced in means, was still formidable in the resources of his genius. At last, his too adventurous project of throwing himself in their rear, enabled them to march to Paris, to enter that capital with little resistance, and to accomplish a complete change in the government of France.

February 1814.

March 31.

The capture of Paris, the recal of the Bourbons, and the cession of Flanders, were events little expected by the French nation, who had been kept in the dark in regard to the overwhelming force of the allies, and the weakness of their own army. These humiliations, and a dread of the revival of the influence of the *noblesse* and clergy, with all the ancient abuses, created a great degree of discontent and dissatisfaction. In so divided a country, Bonaparte was aware that he could not encounter much opposition, and the attachment of the military, still expressed with all the frankness natural to their profession, justified him in anticipating a welcome from every detachment that should be sent to oppose him. Such, and not a recal by any party, were the motives of his most unexpected return, and the causes of his success. No one can form a judgment of the sudden defection that took place, unless he knows the enthusiastic attachment of French soldiers to a successful chief, and the art with which Bonaparte had concentrated their affections on himself to the exclusion even of his marshals. A general dread of a civil war pervaded the revolutionists themselves till he reached Paris, and placed himself, unopposed, at the helm of affairs. The provinces followed the example of the capital. The country at large was tranquil, but the note of war was soon sounded, first on the side of La Vendée, and ere long on that of the Netherlands. The force with which Bonaparte advanced (about 100,000 men) was at first successful by its rapidity and concentration; but it was found wholly unequal to the execution of his daring plans when divided, and opposed with firmness and judgment. It was beaten, routed, dispersed; and, on Bonaparte's return to Paris, the assembled representatives, who had acted from the outset with a degree of independence, wholly opposite to the conduct of the senate of former years, required his immediate abdication.

Louis now re-entered his capital for the second time. His language was firm but moderate. The highest place in his ministry entrusted first to Talleyrand, was soon after conferred on the Duke of Richelieu. Instructions being given for a new parliament, the elections took place under an impression of general animosity towards the revolutionists as instrumental to the late disasters, and produced the return of a chamber impatient for vindictive measures. Party spirit run extremely high, and the majority of the chamber pressed many measures at variance with the moderate views of the King, who at last, on 5th September 1816, took the decisive step of dissolving this parliament, and of enabling his people to make a second election under calmer feelings. From this time forward the King was highly popular with the *liberaux*, and the ultra-royalists postponed their hopes of ascendancy to the accession of a new sovereign.

July 8, 1815.

The years 1817 and 1818 were occupied chiefly with financial discussions, with new-modelling the army, and with obtaining, at first a reduction, and eventually a removal, of the allied army from the French territory. The Duke of Richelieu now thought he might urge a modification of the election law. The majority of the peers were known to favour this course, but Louis thought differently, and, parting with his minister, continued to act under the counsels of Decazes, until the threatened ascendancy of the *liberaux* induced him to accede to the proposed change; to recal the Duke of Richelieu to his councils; to sanction certain restrictions on the language of newspapers; and, by a law *sur la liberté individuelle*, to give his ministers a power similar to that which the government acquires in England by the suspension of the act of *Habeas Corpus*.

November 1818.

December 1818.

February 1820.

April 1820.

(D. D.)

FRISI (Paul), a profound mathematician and astronomer, was born at Milan the 13th April 1728; his family had formerly emigrated from Strasburg, and was established at Milan in an humble station of life.

At the age of fifteen he entered into the convent of the Barnabite friars, or of the congregation of St Paul, where his studies were at first confined to the attainment of some knowledge of geography from the contemplation of the old maps that were pasted on the walls of the galleries; he soon acquired, however, a taste for geometry, and made considerable progress in it without an instructor. He was sent to the University of Pavia, to go through a course of divinity, and he did not neglect the opportunity of applying with increased diligence to the mathematics, with the assistance of Professor Olivetano. He was afterwards removed to Lodi, in order to give lectures there on philosophy; and he soon after distinguished himself by writing a most able Essay on the *Figure of the Earth*, which, however, he had not the means of printing, as his brethren were unwilling to assist him, until he found a patron for his publication in the Count de Silva, who undertook to be at the expense of the impression. The credit which he acquired induced some other members of the society to follow his example, and the convent of the Barnabites at Milan soon began to be converted into a nursery of mathematics. His reputation procured him also, from the King of Sardinia, the appointment of Professor of Philosophy in the College of Casale: here, however, he thought the conduct of his superiors unjust and tyrannical, and they were also dissatisfied with him on account of his great intimacy with Radicati, whose opinions were rather more liberal than they thought it pru-

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dent to tolerate. This friendship was, however, so far of advantage to Frisi, as it tended to improve his taste in modern literature; but it was the principal cause of his being removed to Novara, where he was obliged to undertake the duties of a preacher. In the mean time, he was nominated a correspondent of the Parisian Academy of Sciences in 1753, and received similar honours from other scientific bodies. Soon after this he was recalled to Milan, and made Professor of Philosophy in the great Barnabite college of St Alexander in that city. His dissertation on the *Figure of the Earth* was very acrimoniously attacked by a young Jesuit, who accused him of being improperly led away by English and French innovations, but it was easy for him to repel so unfounded a charge. From this time he entertained much ill humour against the Jesuits in general, and had written a work to depreciate the order, but he was advised by his second brother to suppress it. He became, however, more and more connected with the enemies of the Jesuits, and, among them with D'Alembert, Condorcet, and the other Encyclopédistes. He had before this time declared himself, in his lectures, an enemy to the popular opinion of the Italians respecting magic and witchcraft, though he felt himself in some danger of the animadversions of the Inquisition. He was much in the habit of frequenting the best societies in Milan, and even more than was thought consistent with his religious character; but he was in some measure emancipated from the restraints of his order, by his appointment, in 1756, to a professorship in the University of Pisa, for which he was indebted to the Grand Duke Leopold. This situation he retained for eight years, enjoying the highest degree of credit, and receiving marked attention from all travellers of distinction, and saving, at the same time, a considerable portion of his salary, to which he added the amount of some prizes which he obtained from Berlin and Petersburg in 1756, and from Paris in 1758. Notwithstanding his occupations as a Professor of Moral Philosophy, he had always been in the habit of devoting the greater part of his attention to the mathematical sciences. In 1757 he was made an associate of the Imperial Academy of Petersburg, and a foreign member of the Royal Society of London; in 1758, a member of the Academy of Berlin; in 1766, of that of Stockholm; and in 1770, of the Academies of Copenhagen and of Berne. The Archduke Joseph had sent him, in 1759, a collar with a gold medal, and he received similar marks of distinction from the Kings of Prussia and Denmark. He was also liberally rewarded by Pope Clement XIII. for his services in arranging a dispute between the people of Ferrara and of Bologna on the subject of rivers and torrents, which had been referred to him on the occasion of a tour that he made to Naples and to Rome in 1760. The Senate of Venice also made him a proper acknowledgment for the assistance he gave to the commissioners whom they had appointed to control the ravages of the Brenta. The Empress Maria Theresa settled on him a pension of 100 sequins, or L. 50, a year. He was recalled to Milan in 1764, as Professor of Mathematics in the Palatine schools, with appointments equal to those which he had enjoyed at Pisa, and with the additional advantage of living near his family, and being enabled to promote their interests. He was at various times much engaged in the decision of controversies respecting canals and rivers, and obtained much credit for his skill and ingenuity, though the peculiarities of his temper tended somewhat to increase the number of enemies, which might possibly have been unavoidable. Among other controversies, he was engaged in a dispute respecting the propriety of adding a high pinnacle to the dome of the church at Milan, which has since been raised in opposition to his opinion. In 1766, he undertook a journey into France and England, and his celebrity everywhere procured him the most flattering attentions. At Paris a very liberal proposal was made to him to remove to Lisbon, but he preferred returning to his own country. In 1768 he went to Vienna, and he was consulted by the government there upon some important questions of ecclesiastical policy, in which his advice was adopted. He remained but little longer in the College of St Alexander, and Pope Pius VI. liberated him entirely from subjection to the superiors of his order, and allowed him to wear the habit of a secular priest. As one of the censors of the press, he had incautiously been accessory to the publication of the *Lanterna Curiosa*, the work of a Coffeehouse Club in Milan, which gave great offence to the government; and he afterwards still more imprudently undertook to defend it. This circumstance occasioned his removal from Milan for a time, but he was recalled in 1777, and was appointed director of a school of architecture. He was active in introducing the employment of conductors for security against lightning, and had one fixed for an example on the Repository of the Public Archives; he was equally zealous on every other occasion in the dissemination of useful novelties among his countrymen. In 1778, he made a tour into Switzerland, and his observations there gave rise to his speculations on subterraneous rivers. He enjoyed uninterrupted health until the age of forty-eight, when he was attacked by a hæmorrhoidal affection, ending in an abscess, which, eight years afterwards, required the performance of an operation; this was unfortunately succeeded by a fatal mortification, and he died the 22d November 1784, at the moment when he was about to be placed on the list of the eight foreign associates of the Parisian Academy, an honour which had been delayed by the preference of J. A. Euler, on the occasion of a former vacancy, to the no small mortification of his vanity. He had very lately obtained a prize from the Academy of Haerlem, for his Memoir on the *Inequality of the Satellites of Jupiter*. He was buried in the church of St Alexander, and a medallion with his portrait was placed over his tomb by his brethren the Barnabites. He had four brothers, Antony, a physician, botanist, and chemist; Antony Francis, an ecclesiastic, author of some antiquarian researches of merit; Louis, a canon of St Ambrose, a learned theologian and mechanician; and Philip, a lawyer, author of a dissertation, *De imperio et jurisdictione*.

The works of Father Paul Frisi are, 1. *Disquisi-*

Frisi.

tio mathematica in causam figurae terrae. Milan, 1751; demonstrating, more completely than Newton had done, the spheroidal figure of the earth. 2. *Estratto della storia litteraria d'Italia.* Milan, 1753; an answer to a review. 3. *Saggio della morale filosofia.* Lugano, 1755. 4. *Nova electricitatis theoria.* Milan, 1755: seems to be the same with a dissertation *De existentia et motu ætheris, seu de theoria electricitatis ignis et lucis,* printed with J. A. Euler's *Disquisitio de causa physica electricitatis praemio coronata.* 1755. 4to, Petersburg. This dissertation shows some ingenuity, but is by no means established on firm foundations. Among some other fanciful hypotheses, it suggests that light is probably an impulse transmitted by an elastic medium, but not of an undulatory nature. Both these essays seem to have been republished at Lucca with another by Resaud, under the title of *Dissertationes selectae quae ad I. P. academiam,* anno 1755, missae sunt, 1757. 5. *De motu diurno terrae.* Pisa, 1758; a dissertation which obtained a prize from the Academy of Berlin in 1756. 6. *Dissertationes variae.* 2 vols. 4to, Lucca, 1759, 1761; the first volume containing a geometrical solution of the problem of Precession and Nutation; a Dissertation on the Atmospheres of the Heavenly Bodies, which obtained the prize at Paris in 1758; an Essay on the Nature and Motion of the Ether; the second, a Treatise on the Inequality of the Motion of the Planets, being an enlargement of a prize dissertation which obtained the second premium at Paris in 1760; a Dissertation on the Geometrical method of Fluxions, and some Metaphysical Meditations. 8. *Piano de lavori per liberare dalle acque.* Lucca, 1761; for the use of the provinces of Bologna, Ferrara, and Ravenna. 9. *Del modo di regolare i fiumi e torrenti.* Lucca, 1762, 1760. Flor. 1770, French, Paris, 1774; especially of the Bolognan and Roman territories; making great use of Guglielmini's works; at the end there is an Elogio di Gabriello Manfredi. 10. *Praelectio habita Mediolani.* 1764. 11. *Saggio sopra l'architectura Gotica.* Leghorn, 1766. 12. *Lettre à M. D'Alembert.* Par. 1767. 13. *Elogio del Galileo.* Leghorn and Milan, 1775, French by Floncel, 12mo, Par. 1767; an elegant specimen of biography. 14. *On the supposed inequalities in the rotation of the earth and moon.* Inst. Bologn. Vol. V. Op. p. 11 (1787): the same volume contains a Prospectus of the work on the Laws of Gravity, p. 514. 15. *De gravitate universale libri tres.* 4to, Milan, 1768; a work considered as a model of elegance, simplicity, and facility; leaving, however, the fact of the moon's acceleration still unexplained, and even stating doubts of its existence. 16. *Della maniera di preservare gli edifizi dal fulmine.* Milan, 1768; by conductors. 17. *De inequalitate motus planetarum,* a dissertation which obtained the second premium at Paris in 1768. 18. *Melandri et Frisii de theoria lunae commentarii,* Parma, 1769. 19. *Cosmographia physica et mathematica,* 2 vols. 4to, Milan, 1774, 1775; this is Frisi's principal work; it contains the substance of the three books on the laws of gravity, with additional matter; it is only superseded by the *Mécanique Céleste* in point of practical utility, but still retains the advantage of more satisfactory geometrical representation, and less unnecessary complication in the modes of reasoning employed. 20. *Dell architectura statica e idraulica.* Milan, 1777. 21. *A letter to Melander on the transit of Venus.* *Atti di Sienna,* Vol. IV. p. 21 (1771); with some illustrations of the lunar perturbations. 22. *Geometrical Problems,* Ib. Vol. V. p. 27 (1772); relating to intersections and circles. 23. *Elogi di Galileo e di Cavalieri.* Milan, 1778, Pisa, 1779. 24. *Elogio del Cav. I. Newton.* 8vo. Milan, 1778. 25. *Elogio del Conte D. Silva.* Milan, 1779, anonymous. 26. *Elogio di Tito Pomponio Attico.* Milan, 1780; a compliment to the Count de Firmian. 27. *Opuscoli filosofici.* Milan, 1781; denying the fancied influence of the moon on the weather, which Toaldo very unsuccessfully attempted to assert in answer; with dissertations on Conductors, on the effect of Oil on Water, on the Heat of the Earth, and on Subterraneous Rivers. 28. *On Isoperimetrical Maxima and Minima.* *Atti di Sienna,* Vol. VI. p. 121 (1781); intended as a simpler mode of obtaining the results than that of Euler. 29. *A Collection of his Works,* in three volumes, was begun in 1782, and remained unfinished at the time of his death. The first volume contained Algebra and Geometry; the second, Mechanics and Hydraulics; the third, the Cosmography. 30. *Elogio di Maria Teresa.* Pisa, 1783; anonymous. 31. *Lettera intorno agli studj del Sign. T. Perelli.* Pisa, 1784. 33. *Elogio di D'Alembert.* Milan, 1788; posthumous. 32. *An Essay on Arches and Domes, Atti della Società Patriotica di Milano.* Vol. I. 1783; correcting some statements of Couplet and Belidor.

He left several unpublished works in the hands of his two brothers, 1. On the mediocrity of the Jesuits. 2. Elements of the Cartesian algebra. 3. Institutions of mechanics. 4. Of the restoration of the navigation between Milan and Pavia. 6. *Institutiones hydrometricæ.* 6. Elements of hydrodynamics. 7. Elements of hydraulics. 8. Memoirs of his travels in France and England. 9. Lectures delivered at Pisa. 10. Prælectiones de malis spiritibus. 11. Several miscellaneous dissertations.

(Verri *Memorie del S. D. P. Frisi,* 4. Milan, 1787.—Fabbroni *Elogj d'illustri Italiani.*—*Atti di Milano,* Vol. II.—Chalmers's *Biographical Dictionary,* Vol. XIV. 8. Lond. 1814.—Aikin's *General Biography,* Vol. X. 4. Lond. 1815.—Guillon *in Biographie Universelle,* Vol. XVII. 8. Par. 1816.)

(L.I.)

FUNDING SYSTEM.

Under this head we propose, first, to give an account of the rise, progress, and modifications of the Sinking Fund, accompanied with some observations as to the probability of its accomplishing the object for which it was instituted; and, next, briefly to consider the best mode of providing for our annual expenditure both in war and peace,—an inquiry necessarily involving the policy of that System of Funding of which the Sinking Fund has long been considered as one of the principal recommendations and props.

I. On the subject of the Sinking Fund, we shall have frequent occasion to refer to the statements of Professor Hamilton, in his very valuable publication, entitled, *An Inquiry concerning the Rise and Progress, the Redemption, and Present State of the National Debt of Great Britain.* "The first plan for the discharge of the national debt, formed on a regular system, and conducted with a considerable degree of firmness," says this able writer, "was that of the Sinking Fund, established in 1716. The author of this plan was the Earl of Stanhope; but as it was adopted under the administration of Sir Robert Walpole, it is commonly denominated from him. The taxes which had before been laid on for limited periods, being rendered perpetual, and distributed among the *South Sea, Aggregate,* and *General Funds*, and the produce of these funds being greater than the charges upon them, the surpluses, together with such farther surpluses as might afterwards accrue, were united under the name of the *Sinking Fund,* being appropriated for the discharge of the national debt, and expressly ordained to be applicable to no other purpose whatever. The legal interest had been reduced from six to five *per cent.* about two years before; and as that reduction was unfavourable to the commercial state of the country, government was now able to obtain the same reduction on the interest of the public debt, and apply the savings in aid of the Sinking Fund. In 1727, a further reduction of the interest of the public debt, from five to four *per cent.* was obtained, by which nearly L. 400,000 was added to the sinking fund. And, in the year 1749, the interest of part of the debt was again reduced to $3\frac{1}{2}$ *per cent.* for seven years, and to 3 *per cent.* thereafter; and, in 1750, the interest of the remainder was reduced to $3\frac{1}{2}$ *per cent.* for five years, and to 3 *per cent.* thereafter, by which a further saving of about L. 600,000 was added to the sinking fund."

This sinking fund was for some time regularly applied to the discharge of debt. The sums applied, from 1716 to 1728, amounted to L. 6,648,000, being nearly equal to the additional debt contracted in that time. From 1728 to 1733, L. 5,000,000 more were paid. The interest of several loans, contracted between 1727 and 1732, was charged upon

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surplus duties, which, according to the original plan, ought to have been appropriated to the sinking fund.

"Soon after, the principle of preserving the sinking fund inviolable was abandoned. In 1733, L. 500,000 was taken from that fund, and applied to the services of the year."—"In 1734, L. 1,200,000 was taken from the sinking fund for current services; and, in 1735, it was anticipated and mortgaged." The produce of the sinking fund, at its commencement in 1717, was L. 323,437. In 1776, it was at its highest amount, being then L. 3,166,517; in 1780, it had sunk to L. 2,403,017.

"The sinking fund would have risen higher, had it not been depressed, especially in the latter period, by various encroachments. It was charged with the interest of several loans, for which no provision was made; and, in 1772, it was charged with an annuity of L. 100,000, granted in addition to the civil list. During the three wars which were waged while it subsisted, the whole of its produce was applied to the expence of the war; and even in time of peace, large sums were abstracted from it for current services. According to Dr Price, the amount of public debt paid off by the sinking fund, since its first alienation in 1733, was only three millions, paid off in 1736 and 1737; three millions in the peace between 1748 and 1756; two millions and a half in the peace between 1763 and 1775; in all, eight millions and a half.

"The additional debt discharged during these periods of peace was effected, not by the sinking fund, but from other sources.

"On the whole, this fund did little in time of peace, and nothing in time of war, to the discharge of the national debt. The purpose of its inviolable application was abandoned, and the hopes entertained of its powerful efficacy entirely disappointed. At this time, the nation had no other free revenue, except the land and malt-tax granted annually; and as the land-tax during peace was then granted at a low rate, their produce was inadequate to the expence of a peace establishment, on the most moderate scale. This gave occasion to encroachments on the sinking fund. Had the land-tax been always continued at 4s. in the pound, it would have gone far to keep the sinking fund, during peace, inviolate."

This fund terminated in 1786, when Mr Pitt's sinking fund was established.

To constitute this new fund, one million *per annum* was appropriated to it by Parliament, the capital stock of the national debt then amounting to L. 238,231,248.

This million was to be allowed to accumulate at compound interest, by the addition of the dividends on the stock which it purchased, till it amounted to four millions, from which time it was not further to increase. The four millions were then annually to

be invested in the public funds as before, but the dividends arising from the stock purchased were no longer to be added to the sinking fund for the purpose of being invested in stock; they were to be applied to the diminution of taxes, or to any other object that Parliament might direct.

A further addition to this fund was proposed by Mr Pitt, and readily adopted, in 1792, consisting of a grant of L. 400,000 arising from the surplus of the revenue, and a further *annual* grant of L. 200,000; but it was expressly stipulated, that no relief from taxation should be given to the public, as far as this fund was concerned, till the original million, with its accumulations, amounted to four millions. The addition made to the fund, by the grant of L. 400,000, and of L. 200,000 *per annum*, together with the interest on the stock those sums might purchase, were not to be taken or considered as forming any part of the four millions. At the same time (in 1792), a sinking fund of a new character was constituted. It was enacted, that, besides a provision for the interest of any loan which should thenceforward be contracted, taxes should also be imposed for a one *per cent.* sinking fund on the capital stock created by it, which should be exclusively employed in the liquidation of such particular loan; and that no relief should be afforded to the public from the taxes which constituted the one *per cent.* sinking fund, until a sum of capital stock, equal in amount to that created by the loan, had been purchased by it. That being accomplished, both the interest and sinking fund were to be applicable to the public service. It was calculated, that, under the most unfavourable circumstances, each loan would be redeemed in 45 years from the period of contracting for it. If made in the 3 *per cent.*, and the price of that stock should continue uniformly at 60, the redemption would be effected in 29 years.

In the years 1798, 1799, and 1800, a deviation was made from Mr Pitt's plan, of providing a sinking fund of one *per cent.* on the capital stock created by every loan, for the loans of those years had no sinking fund attached to them. The interest was charged on the war-taxes; and, in lieu of a one *per cent.* sinking fund, it was provided, that the war-taxes should continue during peace, to be then employed in their redemption, till they were all redeemed.

In 1802, Lord Sidmouth, then Mr Addington, was Chancellor of the Exchequer. He being desirous of liberating the war-taxes from the charges with which they were encumbered, proposed to raise new annual permanent taxes for the interest of the loans of which we have just spoken, as well as for that which he was under the necessity of raising for the service of the year 1802; but he wished to avoid loading the public with additional taxes for a one *per cent.* sinking fund on the capitals created by those loans, and which capitals together amounted to L. 86,796,375. To reconcile the stockholder to this arrangement, he proposed to rescind the provision, which limited the fund of 1786, to four millions, and to consolidate the old and the new sinking funds, *i. e.* that which arose from the original million *per annum*, with the addition made to it of L. 200,000 *per annum* subsequently granted, and that which arose from the one *per cent.* on the capital of every loan that had been contracted since 1792. These combined funds he proposed should from that time be applied to the redemption of the whole debt without distinction; that the dividends arising from the stock purchased by the commissioners for the reduction of the national debt should be applied in the same manner; and that this arrangement should not be interfered with till the redemption of the whole debt was effected.

In February 1803 the debt amounted to L. 480,572,470, and the produce of the joint sinking fund to L. 6,311,626. In 1786 the proportion of the sinking fund to the debt was as 1 to 238, in 1792 as 1 to 160, and in 1803 as 1 to 77.

This was the first deviation of importance from Mr Pitt's plan; and this alteration made by Lord Sidmouth was not, perhaps, on the whole, injurious to the stockholder. He lost, indeed, the immediate advantage of an additional sinking fund of L. 867,963, the amount of 1 *per cent.* on the capitals created by the loans of 1798, 1799, 1800, and 1802; "but, in lieu," says Mr Huskisson, "of this sinking fund, a reversionary sinking fund was created to commence, indeed, in about twelve to fifteen years from that time; but to be of such efficacy when it should commence, and to be so greatly accelerated by subsequent additions in its progress, as, under the most unfavourable supposition, to be certain of reducing the whole of this debt within 45 years. This reversionary sinking fund was to arise in the following manner; by continuing the *old* sinking fund at *compound* interest, *after* it should have reached its *maximum* of four millions; and by continuing also the *new* sinking fund or aggregate of the one *per cents* of the loans since 1792, after such one *per cents* should have liquidated the several loans, in respect of which they are originally issued. There is nothing, therefore, in the act of 1802, which is a departure from the spirit of the act of 1792." *

The next alteration that was proposed to be made in the sinking fund was in 1807 by Lord Henry Petty, then Chancellor of the Exchequer. His plan was extremely complicated; and had for its object, that which ministers are too much disposed at all times to view with complacency, namely, to lessen the burthen of taxation at the present, with the certainty of aggravating its pressure at a future day.

It was estimated by Lord Henry Petty that the expences of the country during war would exceed its permanent annual revenue by thirty-two millions. For twenty-one millions of this deficiency, provision was made by the war-taxes, the property-tax amounting to L. 11,500,000, and the other war-taxes to

* Mr Huskisson's *Speech on the State of the Finance and Sinking Fund*, 25th March 1813.

L. 9,500,000. The object then was to provide eleven millions *per annum*. If this sum had been raised by a loan in the three *per cents*, when their price was 60, provision must have been made by taxes for the interest and sinking fund, so that each year we should have required additional taxes to the amount of L. 733,333. But Government wished to raise the money without imposing these additional taxes, or by the imposition of as few as circumstances would permit. For this purpose, they proposed to raise the money required, by loan, in the usual way, but to provide, out of the war-taxes, for the interest and redemption of the stock created. They proposed to increase the sinking fund of every such loan, by taking from the war-taxes 10 *per cent.* on its amount for interest and sinking fund, so that if the interest and management absorbed only 5 *per cent.*; the sinking fund would also amount to 5 *per cent.*, if the interest amounted to 4 *per cent.*, the sinking fund would be 6 *per cent.* The sums proposed to be borrowed, in this manner, were twelve millions for the first three years, fourteen millions for the fourth, and sixteen millions for each succeeding year, making together, in fourteen years, 210 millions, for which, at the rate of 10 *per cent.*, the whole of the war-taxes would be mortgaged. It was calculated, that, by the operation of the sinking fund, each loan would be paid off in fourteen years from the time of contracting for it; and, therefore, the L. 1,200,000 set apart for the interest and sinking fund of the first loan would be liberated and available for the loan of the fifteenth year. At the end of fifteen years a like sum would be set free, and so on each succeeding year, and thus loans might be continued on this system, without any limitation of time.

But these successive sums could not be withdrawn from the war-taxes, for interest and sinking fund on loans, and be at the same time applied to expenditure; and, therefore, the deficiency of eleven millions, for which provision was to be made, would, from year to year, increase as the war-taxes became absorbed, and at the end of fourteen years, when the whole twenty-one millions of the war taxes would be absorbed, instead of eleven millions, the deficiency would be thirty-two millions.

To provide for this growing deficiency, it was proposed to raise supplementary loans, increasing in amount from year to year; and for the interest and sinking fund on such loans, provision was to be made in the usual way by annual permanent taxes; on these loans the sinking fund was not to be more than 1 *per cent.*

By the plan proposed, in fifteen years from its commencement, on the supposition of the war continuing so long, the regular loan would have been twelve millions, and the supplementary loan twenty millions.

If the expences of the war should *have exceeded* the estimate then made, provision for such excess was to *have been* made by other means.

The ministry who proposed this plan, not continuing in office, the plan was acted upon only for one year. " In comparing the merit of different systems," says Dr Hamilton, " the only points necessary to be attended to are the amount of the loans contracted—the part of these loans redeemed—the interest incurred—and the sums raised by taxes. The arrangements of the loan under different branches, and the appropriation of particular funds for payment of their respective interests, are matters of official regulation; and the state of the public finance is neither the better nor the worse, whether they be conducted one way or other. A complicated system may perplex and mislead, but it can never ameliorate." Accordingly, Dr Hamilton has shown, that the whole amount of taxes that would have been paid in twenty years, for an annual loan of eleven millions on the old plan of a sinking fund of 1 *per cent.*, would be 154 millions. On Lord Henry Petty's plan, these taxes would, in the same time, have been ninety-three millions,—a difference in favour of Lord Henry Petty's plan of fifty-one millions; but to obtain this exemption we should have been encumbered with an additional debt of L. 119,489,788 of money capital, which, if raised in a 3 *per cent.* stock at 60, would be equal to a nominal capital of L. 199,149,646.

The sinking fund was established with a view to diminish the national debt during peace, and to prevent its rapid increase during war. The only wise and good object of war-taxes is also to prevent the accumulation of debt. A sinking fund and war-taxes are only useful while they are strictly applied to the objects for which they are raised; they become instruments of mischief and delusion when they are made use of for the purpose of providing the interest on a new debt.

In 1809, Mr Perceval, who was then Chancellor of the Exchequer, mortgaged L. 1,040,000 of the war-taxes for the interest and sinking fund of the stock he funded in that year.

By taking more than a million from the war-taxes, not for the annual expenditure, but for the interest of a loan, Mr Perceval rendered it necessary to add one million to the loan of the next and all following years; so that the real effect of this measure differed in no respect from one which should have taken the same sum annually from the sinking fund.

In 1813, the next, and most important alteration was made in the sinking fund. Mr Vansittart was then Chancellor of the Exchequer. It has been already observed, that the national debt amounted to L. 238,231,248 in 1786, when Mr Pitt established his sinking fund of one million. By the act of 1786, as soon as the sum of one million amounted, by the aid of the dividends on the stock, which was to be purchased by it, to four millions, its accumulation was to cease, and the dividends on the stock purchased were to be available for the public service. If the 3 *per cents.* were at 60, when this million had accumulated to four millions, the public would have had a disposable fund of L. 20,000 *per annum*; if at 80, of L. 15,000 *per annum*; and no other relief was to be given to the public till the four millions had purchased the whole sum of 238 millions, the then amount of the debt. In 1792 Mr Pitt added L. 200,000 *per annum* to the sinking fund, and accompanied it by the following observations: " When the sum of four millions was originally fixed as the limit for the sinking fund, it was not in contemplation to issue more annually from the surplus revenue

than one million; consequently, the fund would not rise to four millions, till a proportion of debt was paid off, the interest of which, together with the annuities which might fall in, in the interval, should amount to three millions. But, as on the present supposition, additional sums beyond the original million are to be annually issued from the revenue, and applied to the aid of the sinking fund, the consequence would be, that, if that fund, with these additions carried to it, were still to be limited to four millions, it would reach that amount, and cease to accumulate, before as great a portion of the debt is reduced as was originally in contemplation." "In order to avoid this consequence, which would, as far as it went, be a relaxation in our system, I should propose, that whatever may be the additional annual sums applied to the reduction of debt, the fund should not cease to accumulate till the interest of the capital discharged, and the amount of the expired annuities should, together with the annual million only, and exclusive of any additional sums, amount to four millions." *

It will be recollected, that, in 1792, a provision was made for attaching a sinking fund of 1 per cent. to each loan separately, which was to be exclusively employed in the discharge of the debt contracted by that loan, but no part of these one *per cents.* were to be employed in the reduction of the original debt of L.238,000,000. The act of 1802 consolidated all these sinking funds, and the public were not to be exempted from the payment of the sinking fund itself, nor of the dividends on the stock to be purchased by the commissioners, till the whole debt existing in 1802 was paid off. Mr Vansittart proposed to repeal the act of 1802, and to restore the spirit of Mr Pitt's act of 1792. He acknowledged, that it would be a breach of faith to the national creditor if the fair construction of that act, the act of 1792, were not adhered to. It was, in Mr Vansittart's opinion, no breach of faith to do away the conditions of the act of 1802. Supposing, however, that the act of 1802 had been really more favourable to the stockholder than that of 1792, it is not easy to comprehend by what arguments it can be proved not to be a breach of faith, to repeal the one and enact the other. Were not all the loans from 1802 to 1813 negotiated on the faith of that act? Were not all bargains made between the buyer and seller of stock made on the same understanding? Government had no more right to repeal the act of 1802, and substitute another less favourable to the stockholder, and acknowledged to be so by the minister himself, than it would have had to get rid of the sinking fund altogether. But what we are at present to inquire into is, whether Mr Vansittart did as he professed to do? Did he restore the stockholder to all the advantages of the act of 1792? In the first place, it was declared by the new act, that as the sinking fund consolidated in 1802, had redeemed L.238,350,143, 18s. 1d. exceeding the amount of the debt in 1786 by L.118,895, 12s. 10½d., a sum of capital stock equal to the total capital of the public debt, existing on the 5th January 1786, viz. L.238,231,248, 5s. 2¾d. had been satisfied and discharged; "and that, in like manner, an amount of public debt equal to the capital and charge of every loan contracted since the said 5th January 1786, shall successively and in its proper order, be deemed and declared to be wholly satisfied and discharged, when and as soon as a further amount of capital stock, not less than the capital of such loan, and producing an interest equal to the dividends thereupon, shall be so redeemed or transferred."

It was also resolved, "that after such declaration as aforesaid, the capital stock purchased by the commissioners for the reduction of the national debt, shall from time to time be cancelled; at such times, and in such proportions, as shall be directed by any act of Parliament to be passed for such purpose, in order to make provision for the charge of any loan or loans thereafter to be contracted."

It was also resolved, that, in order to carry into effect the provisions of the acts of the 32d and 42d of the King, for redeeming every part of the national debt within the period of 45 years from the time of its creation, it is also expedient that, in future, whenever the amount of the sum to be raised by loan, or by any other addition to the public funded debt, shall in any year exceed the sum estimated, to be applicable in the same year to the reduction of the public debt, an annual sum equal to one-half of the interest of the excess of the said loan or other addition, beyond the sum so estimated to be applicable, shall be set apart out of the monies composing the consolidated fund of Great Britain; and shall be issued at the receipt of the Exchequer to the Governor and Company of the Bank of England, to be by them placed to the account of the commissioners for the reduction of the national debt; † and upon the remainder of such loan or other addition, the annual sum of 1 *per cent.* on the capital thereof, according to the provisions of the said act of the 32d year of his present Majesty.

A provision was also made, for the first time, for 1 *per cent.* sinking fund on the unfunded debt then existing, or which might thereafter be contracted.

In 1802, it has been already observed, it was deemed expedient that no provision should be made for a sinking fund of 1 *per cent.* on a capital of L.86,796,300; and as it was considered by the proposer of the new regulation in 1813, that he was reverting to the principle of Mr Pitt's act of 1792, he provided that L.867,963 should be added to the sinking fund for the 1 *per cent.* on the capital stock

* Mr Pitt's Speech, 17th February 1792.

† The effect of this clause was to give a sinking fund of 1½ instead of 1 *per cent.* on such excess of loan above the sinking fund, if the loan were raised in a 3 *per cent.* stock, and of 2½ *per cent.* if raised in a 5 *per cent.* stock.

created, and which was omitted to be provided for in 1802.*

This was the substance of Mr Vansittart's new plan, and which he contended was not injurious to the stockholder, as it strictly conformed to the spirit of Mr Pitt's act of 1792.

1*st*, By Mr Pitt's act, no relief could be afforded to the public from the burthens of taxation, till the stock redeemed by the original sinking fund of one million amounted to such a sum as that the dividends on the capital stock redeemed should amount to three millions, making the whole sinking fund four millions; from thenceforth the four millions were to discharge debt as before, but the interest of debt so discharged was to be available for the public service, and the public was not to be relieved from the charge on the remainder of the debt of 238 millions till the four millions, at simple interest, and the further sinking fund which might arise from the falling in of terminable annuities, together with the additional sum of L. 200,000 *per annum*, voted in 1792, with their accumulations, had redeemed the capital of 238 millions. The sinking fund arising from the 1 *per cent.* on each loan, was directed, by the act of 1792, to be applied to each separate loan for which it was raised. Mr Vansittart thought himself justified and free from any breach of faith to the stockholder, in taking for the public service, not the interest of four millions, which is all that Mr Pitt's bill would allow him to take, but the interest on 238 millions: And on what plea? because the whole consolidated sinking funds, comprising the 1 *per cent.* on every loan raised since 1793, had purchased 238 millions of stock. On Mr Pitt's plan, he might have taken L. 20,000 *per annum* from the sinking fund; on his own construction of that act, he took from it more than seven millions *per annum.*

2*dly*, Mr Vansittart acknowledged, that the stockholder, in 1802, was deprived of the advantage of 1 *per cent.* sinking fund on a capital of L.86,796,300, and therefore to be very just, he gives, in 1813, 1 *per cent.* on that capital; but should he not have added the accumulation which would have been made in the eleven years, from 1802 to 1813, on L.867,963, at compound interest, and which would have given a further addition to the sinking fund of more than L.360,000 *per annum*;

3*dly*, On Mr Pitt's plan, every loan was to be redeemed by its sinking fund, under the most unfavourable circumstances, in 45 years. If the loan was raised in a 3 *per cent.* fund at 60, and the stock was uniformly to continue at that price, a 1 *per cent.* sinking fund would redeem the loan to which it was attached in 29 years; but then no relief would be given to the public from taxation till the end of 29 years; and, if there had been loans of ten millions every year for that period, when the first loan was paid off, the second would require only one year for its final liquidation; the third two years, and so on. On Mr Vansittart's plan, under the same circumstances, the sinking fund of each and every loan was to be applied, in the first instance, to the redemption of the first loan; and when that was redeemed and cancelled, the whole of the sinking funds were to be applied to the payment of the second; and so on successively. The first loan of ten millions would be cancelled in less than 13 years, the second in less than six years after the first, the third in a less time, and so on. At the end of the 13th year, the public would be relieved from the interest on the first loan, or, which is the same thing, from the necessity of finding fresh taxes for a new loan at the end of 13 years, for two new loans at the end of 19 years; but what would be the state of its debt at either of these periods, or at the end of 29 years? Could this advantage be obtained without a corresponding disadvantage? No; the excess of debt on Mr Vansittart's plan would be exactly equal to these various sums, thus prematurely released by cancelled stock, accumulated at compound interest. How could it be otherwise? Is it possible that we could obtain a present relief from the charge of debt without either directly or indirectly borrowing the fund necessary to provide that relief at compound interest? "By this means," says Mr Vansittart, "the loan first contracted would be discharged at an earlier period, and the funds charged with the payment of its interest would become applicable to the public service. Thus, in the event of a long war, a considerable resource might accrue during the course of the war itself, as every successive loan

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* Mr Vansittart's plan has added to the sinking fund 1 *per cent.* on a capital of L. 86,796,300,	L. 867,963
On fifty-six millions of Exchequer bills outstanding, 5th January 1818, 1 *per cent.* -	560,000
By attaching a sinking fund of one-half the interest, instead of 1 *per cent.* on a part of the capital created by loans, *he has added to the sinking fund*, - -	793,343
Total added, - -	L. 2,221,311
From stock, cancelled and available for public service, - - -	7,632,969
Total deduction from sinking fund, on 5th January 1819,	L. 5,411,658

On the 3d of February 1819, the Commissioners certified, that there had been transferred to them L. 378,519,969, 5s. 3¾d. capital stock, the interest on which was L. 11,448,564, 10s. 6¼d., and that the debt created prior to, and by the 37th Geo. III. amounted to L. 348,684,197, 1s. 5¾d., with a yearly interest of L. 11,446,736, 3s. 4¾d.; and, consequently, the excess redeemed was L. 29,835,772, 3s. 9¼d., with a yearly interest of L. 1828, 7s. 1¼d. Of the above sum of L. 11,448,564, L. 7,632,969 only has been cancelled.

would contribute to accelerate the redemption of those previously existing; and the total amount of charge to be borne by the public, in respect of the public debt, would be reduced to a narrower compass than in the other mode, in which a greater number of loans would be co-existing. At the same time, the ultimate discharge of the whole debt would be rather accelerated than retarded." "It is now only necessary to declare, that an amount of stock equal to the whole of the debt existing in 1786 has been redeemed; and that, in like manner, whenever an amount of stock equal to the capital and charge of any loan raised since 1792 shall be redeemed, in its proper order of succession, such loan shall be deemed and taken to be redeemed and satisfied. Every part of the system will then fall at once into its proper place; and we shall proceed with the future redemption with all the advantages which would have been derived from the original adoption of the mode of successive instead of simultaneous redemption. Instead of waiting till the purchase of the whole of the debt consolidated in 1802 shall be completed, that part of it which existed previously to 1792 will be considered as already redeemed, and the subsequent loans will follow in succession, whenever equal portions of stock shall have been purchased. *It is satisfactory to observe, that, by a gradual and equable progress, we shall still have the power of effecting the complete repayment of the debt more speedily than by the present course.*" Is it possible that Mr Vansittart could so deceive himself as to believe that, by taking five millions from the sinking fund, which would not have been taken by the provisions of the act of 1802, which would not have been taken by the act of 1792, and other sums successively, in shorter times than could have been effected by the provisions of those two acts, he would be enabled to complete the repayment of the debt more speedily? Is it possible that he could believe that, by diminishing the sinking fund, that is, the amount of revenue as compared with expenditure, he would effect the payment of our debt more speedily? It is impossible to believe this. How then are his words to be accounted for? In one way he might have a meaning. It might be this, —I know we shall be more in debt in 10, 20, and 30 years, on my plan, than we should have been on that of Lord Sidmouth, or on that of Mr Pitt; but we shall have effected a greater payment, in that time, of *the stock now existing*; as the sinking funds attached to future loans will be employed in paying our present debt. On Mr Pitt's plan, those sinking funds would be used for the payment of the new debt to be created; that is to say, of the loans to which they are respectively attached. We shall be more in debt at every subsequent period, it is true; but, as our debt may be divided into old stock and new stock, I am correct when I say, that we shall have the power of completing the repayment of the debt, meaning by the debt the stock now existing, sooner than by the present course.

This plan of Mr Vansittart was opposed with great ability, both by Mr Huskisson and Mr Tierney. The former gentleman said, "The very foundation of the assumption that the old debt has been paid off, is laid in the circumstance of our having incurred a new debt, of a much larger amount; and, even allowing that assumption, Mr Vansittart would not have been able to erect his present scheme upon it, if the credit of the country had not been, for the last twenty years, materially impaired by the pressure of that new debt. On the one hand, had the sinking fund been operating at 3 *per cent.* during that period, he would not have touched it, even under his own construction of the act of 1792. On the other hand, had the price of the stocks been still lower than it has been, he would have taken from that sinking fund still more largely than he is now, according to his own rule, enabled to take. This, then, is the new doctrine of the sinking fund;—that, having been originally established "to prevent the inconvenient and dangerous accumulation of debt hereafter" (to borrow the very words of the act), and for the support and improvement of public credit, it is in the accumulation of new debt that Mr Vansittart finds at once the means and the pretence for invading that sinking fund; and the degree of depression of public credit is, with him, the measure of the extent to which that invasion may be carried. And this is the system of which it is gravely predicated, that it is no departure from the letter, and no violation of the spirit, of the act of 1792; and of which we are desired seriously to believe, that it is only the following up and improving upon the original measure of Mr Pitt!—of which measure the clear and governing intention was, that every future loan should, from *the moment of its creation*, carry with it the seeds of its destruction; and that the course of its reimbursement should, *from that moment*, be placed beyond the discretion and control of parliament."—Mr Huskisson's *Speech*, 25th March 1813.

This is the last alteration that has taken place in the *machinery* of the sinking fund. Inroads more fatal than this which we have just recorded have been made on the fund itself; but they have been made silently and indirectly, while the machinery has been left unaltered.

It has been shown by Dr Hamilton, that no fund can be efficient for the reduction of debt but such as arises from an excess of revenue above expenditure.

Suppose a country at peace, and its expenditure, including the interest of its debt, to be forty millions, its revenue to be forty-one millions, it would possess one million of sinking fund. This million would accumulate at compound interest; for stock would be purchased with it in the market, and placed in the names of the commissioners for paying off the debt. These commissioners would be entitled to the dividends before received by private stockholders, which would be added to the capital of the sinking fund. The fund thus increased would make additional purchases the following year; and would be entitled to a larger amount of dividends; and thus would go on accumulating, till in time the whole debt would be discharged.

Suppose such a country to increase its expenditure one million, without adding to its taxes, and to keep up the machinery of the sinking fund; it is evident, that it would make no progress in the reduc-

tion of its debt, for, though it would accumulate a fund in the same manner as before in the hands of the commissioners, it would, by means of adding to its funded or unfunded debt, and by constantly borrowing, in the same way, the sum necessary to pay the interest on such loans, accumulate its million of debt annually, at compound interest, in the same manner as it accumulated its million annually of sinking fund.

But suppose that it continued its operations of investing the sinking fund in the purchase of stock, and made a loan for the million which it was deficient in its expenditure, and that, in order to defray the interest and sinking fund of such loan, it imposed new taxes on the people to the amount of L. 60,000, the real and efficient sinking fund would, in that case, be L. 60,000 *per annum* and no more, for there would be L. 1,060,000 and no more to invest in the purchase of stock, while one million was raised by the sale of stock, or, in other words, the revenue would exceed the expenditure by L.60,000.

Suppose a war to take place, and the expenditure to be increased to sixty millions, while its revenue continued as before forty-one millions, still keeping on the operation of the commissioners, with respect to the investment of one million. If it were to raise war-taxes for the payment of the twenty millions additional expence, the million of sinking fund would operate to the reduction of the national debt at compound interest as it did before. If it raised twenty millions by loan in the stocks or in exchequer bills, and did not provide for the interest by new taxes, but obtained it by an addition to the loan of the following year, it would be accumulating a debt of twenty millions at compound interest, and while the war lasted, and the same expenditure continued, it would not only be accumulating a debt of twenty millions at compound interest, but a debt of twenty millions *per annum*, and, consequently, the real increase of its debt, after allowing for the operation of the million of sinking fund, would be at the rate of nineteen millions *per annum* at compound interest. But if it provided by new taxes 5 *per cent.* interest for this annual loan of twenty millions, it would, on one hand, simply increase the debt twenty millions *per annum*; on the other, it would diminish it by one million *per annum*, with its compound interest. If we suppose that, in addition to the 5 *per cent.* interest, it raised also by annual taxes L. 200,000 *per annum*, as a sinking fund, for each loan of twenty millions, it would, the first year of the war, add L.200,000 to the sinking fund; the second year L. 400,000; the third year L. 600,000, and so on, L. 200,000 for every loan of twenty millions. Every year it would add, by means of the additional taxes, to its annual revenue, without increasing its expenditure. Every year too that part of this revenue which was devoted to the purpose of purchasing debt, would increase by the amount of the dividends on the stock purchased, and thus would its revenue still farther increase, till at last the revenue would overtake the expenditure, and then once again it would have an efficient sinking fund for the reduction of debt.

It is evident, that the result of these operations would be the same, the rate of interest being supposed to be always at 5 *per cent.* or any other rate, if, during the excess of expenditure above revenue, the operation of the commissioners in the purchase of stock were to cease. The real increase of the national debt must depend upon the excess of expenditure above revenue, and that would be no ways altered by a different arrangement. Suppose that, instead of raising twenty millions the first year, and paying off one million, only nineteen millions had been raised by loan, and the same taxes had been raised, namely, L. 1,200,000. As 5 *per cent.* would be paid on nineteen millions only, instead of on twenty millions, or L. 950,000 for interest instead of one million, there would remain, in addition to the original million, L. 250,000 towards the loan of the following year, consequently, the loan of the second year would be only for L.18,750,000,—but as L.1,200,000 would be again raised by additional taxes, or L.2,400,000 in the whole the second year, besides the original million, there would be a surplus, after paying the interest of both loans, of L. 1,512,500, and therefore the loan of the third year would be for L.18,487,500. The progress during five years is shown in the following table:

	Loan each Year.	Amount of Loans.	Amount of Interest.	Amount of Taxes.	Surplus.
1st year	L.19,000,000	19,000,000	950,000	2,200,000	1,250,000
2d year	18,750,000	37,750,000	1,887,500	3,400,000	1,512,500
3d year	18,487,500	56,237,500	2,811,875	4,600,000	1,788,125
4th year	18,211,875	74,449,375	3,722,469	5,800,000	2,077,531
5th year	17,922,469	92,371,844	4,618,592	7,000,000	2,381,408

If, instead of thus diminishing the loan each year, the same amount of taxes precisely had been raised, and the sinking fund had been applied in the usual manner, the amount of debt would have been exactly the same at any one of these periods. In the third column of the above table it will be seen that, in the 5th year, the debt had increased to L. 92,371,844. On the supposition that L. 200,000 *per annum* had each year been added to the sinking fund, and invested in stock by the commissioners, the amount of unredeemed debt would have been the same sum of L. 92,371,844, as will be seen by the last column of the following table:

	Loan each Year.	Amount of Loans.	Debt redeemed each Year.	Amount Debt Redeemed.	Interest on Debt Redeemed.	Debt remaining Unredeemed.
1st year	L. 20,000,000	20,000,000	1,000,000	1,000,000	50,000	19,000,000
2d year	20,000,000	40,000,000	1,250,000	2,250,000	112,500	37,750,000
3d year	20,000,000	60,000,000	1,512,500	3,762,500	188,125	56,237,500
4th year	20,000,000	80,000,000	1,788,125	5,550,625	277,531	74,449,375
5th year	20,000,000	100,000,000	2,077,531	7,628,156	381,408	92,371,844

A full consideration of this subject, in all its details, has led Dr Hamilton to the conclusion, that this first mode of raising the supplies during war, viz. by diminishing the amount of the annual loans, and stopping the purchases of the commissioners in the market, would be more economical, and that it ought therefore to be adopted. In the first place, all the expences of agency would be saved. In the second, the premium usually obtained by the contractor for the loan would be saved, on that part of it which is repurchased by the commissioners in the open market. It is true that the stocks may fall as well as rise between the time of contracting for the loan, and the time of the purchases made by the commissioners; and, therefore, in some cases, the public may gain by the present arrangement; but as these chances are equal, and a certain advantage is given to the loan contractor to induce him to advance his money, independently of all contingency of future price, the public now give this advantage on the larger sum instead of on the smaller. On an average of years this cannot fail to amount to a very considerable sum. But both these objections would be obviated, if the clause in the original sinking fund bill, authorizing the commissioners to subscribe to any loan for the public service, to the amount of the annual fund which they have to invest, were uniformly complied with. This is the mode which has, for several years, been strongly urged on ministers by Mr Grenfell, and is far preferable to that which Dr Hamilton recommends. Dr Hamilton and Mr Grenfell both agree, that, in time of war, when the expenditure exceeds the revenue, and when, therefore, we are annually increasing our debt, it is a useless operation to buy a comparatively small quantity of stock in the market, while we are at the same time under the necessity of making large sales; but Dr Hamilton would not keep the sinking fund as a separate fund, Mr Grenfell would, and would have it increased with our debt by some known and fixed rules. We agree with Mr Grenfell. If a loan of twenty millions is to be raised annually, while there is in the hands of the commissioners ten millions which they annually receive, the obvious and simple operation should be really to raise only ten millions by loan; but there is a convenience in calling it twenty millions, and allowing the commissioners to subscribe ten millions. All the objections of Dr Hamilton are by these means removed; there will be no expence for agency; there will be no loss on account of any difference of price at which the public sell and buy. By calling the loan twenty millions, the public will be induced more easily to bear the taxes which are necessary for the interest and sinking fund of twenty millions. Call the loan only ten millions, abolish, during the war, the very name of the sinking fund in all your public accounts, and it would be difficult to show to the people the expediency of providing L. 1,200,000 *per annum* by additional taxation, for the interest of a loan of ten millions. The sinking fund is, therefore, useful as an engine of taxation; and, if the country could depend on ministers, that it would be faithfully devoted to the purposes for which it was established, namely, to afford at the termination of war a clear additional surplus revenue beyond expenditure, in proportion to the addition made to the debt, it would be wise and expedient to keep it as a separate fund, subject to fixed rules and regulations.

We shall presently inquire, whether there can be any such dependence; and, therefore, whether the sinking fund is not an instrument of mischief and delusion, and really tending rather to increase our debt and burthens than to diminish them.

It is objected both to Dr Hamilton's and Mr Grenfell's projects, that the disadvantages which they mention are trifling in degree, and are more than compensated by the steadiness which is given to the market by the daily purchases of the commissioners,—that the money which those purchases throw into the market is a resource on which bankers and others, who may suddenly want money, with certainty rely.

Those who make this objection forget, that, if by the adoption of this plan, a daily purchaser is withdrawn from the market, so also is a daily seller. The minister gives now to one party ten millions of money to invest in stock, and to another party as much stock as ten millions costs to sell; and as the instalments on the loan are paid monthly, it may fairly be said that the supply is as regular as the demand. It cannot be doubted, too, that a loan of twenty millions is negotiated on worse terms than one of ten; it is true that no more stock will remain in the market at the end of the year, whether the one or the other sum be raised by loan; but for a time the contractor must make a large purchase, and he must wait before he can make his sale of ten millions to the commissioners. He is induced then to sell much more largely before the contract, which cannot fail to affect the market price; and it must be recollected, that it is the market price on the day of bidding for the loan which governs the terms on which the loan is negotiated. It is looked to both by the minister who sells, and the contractor who purchases. The experiment on Mr Grenfell's suggestion was tried for the first time in the present year, 1819; the sum required by Government was twenty-four millions, to which the commissioners subscribed twelve millions. In lieu of a loan of twenty-four millions from the contractor, there was one only of twelve millions; and as soon as this arrangement was known,

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previous to the contract, the stocks rose 4 or 5 *per cent.*, and influenced the terms of the loan in that degree. The reason was, that a preparation had been made for twenty-four or thirty millions loan, and as soon as it was known that it would be for twelve millions only, a part of the stock sold was repurchased. Another advantage attending the smaller loan is that 800 *per* million which is paid to the bank for management of the loan is saved on the sum subscribed by the commissioners.

Dr Hamilton, in another part of his work, observes, "If the sinking fund could be conducted without loss to the public, or even if it were attended with a moderate loss, it would not be wise to propose an alteration of a system which has gained the confidence of the public, and which points out a rule of taxation that has the advantage at least of being steady. If that rule be laid aside, our measures of taxation might become entirely loose.

"The means, and the only means, of restraining the progress of national debt are, saving of expenditure, and increase of revenue. Neither of these has a necessary connection with a sinking fund. But, if they have an eventual connection; and, if the nation, impressed with a conviction of the importance of a system established by a popular minister, has, in order to adhere to it, adopted measures, either of frugality in expenditure, or exertion in raising taxes, which it would not otherwise have done, the sinking fund ought not to be considered as inefficient, and its effects may be of great importance."

It will not, we think, admit of a doubt, that if Mr Pitt's sinking fund, as established in 1792, had been always fairly acted upon, if, for every loan, in addition to the war taxes, the interest, and a 1 *per cent.* sinking fund, had been invariably supplied by annual taxes, we should now be making rapid progress in the extinction of debt. The alteration in principle which was made in the sinking fund by the act of 1802 was, in our opinion, a judicious one; it provided, that no part of the sinking fund, neither that which arose from the original million, with its addition of L. 200,000 *per annum,* nor that which arose from the 1 *per cent.* raised for the loans since 1792, should be applicable to the public service, till the whole of the debt then existing was redeemed. We should have been disposed to have extended this principle further, and to have made a provision, that no part of the sinking fund should be applicable to the public service, until the whole of the debt then existing, *and subsequently to be created*, should be redeemed. We do not think that there is much weight in the objection to this clause, which was made to it by Lord Henry Petty in 1807, and referred to, and more strongly urged by Mr Vansittart in 1813. The noble Lord said, "I need hardly press upon the consideration of the committee, all the evils likely to result from allowing the sinking fund to accumulate without any limit; for the nation would be exposed, by that accumulation, to the mischief of having a large portion of capital taken at once out of the market, without any adequate means of applying it, which would, of course, be deprived of its value.

"This evil must appear so serious to any man who contemplates its character, that I have no doubt it will be felt, however paradoxical it may seem, that the redemption of the whole national debt at once would be productive of something like national bankruptcy, for the capital would be equivalent almost to nothing, while the interest he had before derived from it would be altogether extinguished. The other evils which would arise from, and which must serve to demonstrate the mischievous consequence of a prompt discharge of the national debt, I will show presently. Different arrangements were adopted in the further provisions made on the subject of the sinking fund in 1792 and in 1802. By the first the sinking fund of 1 *per cent.*, which was thenceforward to be provided for every new loan, was made to accumulate at compound interest until the whole of the debt created by such new loan should be extinguished. And, by the second arrangement, all the various sinking funds existing in 1802 were consolidated, and the whole were appropriated to accumulate at compound interest until the discharge of the whole of the debt also existing in 1802. But the debt, created since 1802, amounting to about one hundred millions of nominal capital, is still left subject to the acts of 1792, which provides for each separate loan a sinking fund of only 1 *per cent.* on the nominal capital. The plan of 1802, engrafted on the former acts of 1786 and 1792, provided for the still more speedy extinction of the debt to which it applied. But it would postpone all relief from the public burthens to a very distant period (computed, in 1802, to be from 1834 to 1844); and it would throw such large and disproportionate sums into the money market in the latter years of its operation, as might produce a very dangerous depreciation of the value of money. Many inconveniences might also arise from the sudden stop which would be put to the application of those sums when the whole debt should have been redeemed, and from the no less sudden change in the price of all commodities, which must follow from taking off at one and the same moment taxes to an extent probably then much exceeding thirty millions. The fate of merchants, manufacturers, mechanics, and every description of dealers, in such an event, must be contemplated by every thinking man with alarm; and this applies to my observation respecting a national bankruptcy, for, should the national debt be discharged, and such a weight of taxation taken off at once, all the goods remaining on hand would be, comparatively speaking, of no value to the holders, because, having been purchased or manufactured while such taxation prevailed, they must be undersold by all those who might manufacture the same kind of goods after such taxation had ceased. These objections were foreseen, and to a certain degree acknowledged, at the time when the act of 1802 was passed: and it was then answered, that, whenever the danger approached, it might be obviated by subsequent arrangements." A great many of these objections appear to us to be chimerical, but, if well founded, we agree with the latter part of the extract, "whenever the danger approached, it might be obviated by subsequent arrangements." It was not necessary to legislate in

1807, or in 1813, for a danger which could not happen till between 1834 and 1844. It was not necessary to provide against the evils which would arise from a plethora of wealth at a remote period, when our real difficulty was how to supply our immediate and pressing wants.

What are the evils apprehended from the extravagant growth of the sinking fund, towards the latter years of its existence? Not that taxation will be increased, because the growth of the sinking fund is occasioned by dividends on stock purchased; but first, that capital will be returned too suddenly into the hands of the stockholder, without his having any means of deriving a revenue from it; and, secondly, that the remission of taxes, to the amount probably of thirty millions, will have a great effect on the prices of particular commodities, and will be very pernicious to the interest of those who may deal in or manufacture such commodities.

It is obvious that the commissioners have no capital. They receive quarterly, or daily, certain sums arising from the taxes, which they employ in the redemption of debt. One portion of the people pay what another portion receive. If the payers employed the sums paid as capital, that is to say, in the production of raw produce, or manfactured commodities, and the receivers, when they received it, employed it in the same manner, there would be little variation in the annual produce. A part of that produce might be produced by A instead of by B; not that even this is a necessary consequence, for A, when he received the money for his debt, might lend it to B, and might receive from him a portion of the produce for interest, in which case B would continue to employ the capital as before. On the supposition, then, that the sinking fund is furnished by capital and not by revenue, no injury would result to the community, however large that fund might be,—there might or might not be a transfer of employments, but the annual produce, the real wealth of the country, would undergo no deterioration, and the actual amount of capital employed would neither be increased nor diminished. But if the payers of taxes, for the interest and sinking fund of the national debt, paid them from revenue, then they would retain the same capital as before in active employment, and as this revenue, when received by the stockholder, would be by him employed as capital, there would be, in consequence of this operation, a great increase of capital,—every year an additional portion of revenue would be turned into capital, which could be employed only in furnishing new commodities to the market. Now the doubts of those who speak of the mischievous effects of the great accumulation of the sinking fund, proceed from an opinion they entertain that a country may possess more capital than it can beneficially employ, and that there may be such a glut of commodities, that it would be impossible to dispose of them on such terms as to secure to the producers any profits on their capitals. The error of this reasoning has been made manifest by M. Say, in his able work *Economie Politique*, and afterwards by Mr Mill, in his excellent reply to Mr Spence, the advocate of the doctrine of the Economistes. They show that demand is only limited by production; whoever can produce has a right to consume, and he will exercise his privilege to the greatest extent. They do not deny that the demand for particular commodities is limited, and therefore they say, there may be a glut of such commodities, but in a great and civilized country, wants, either for objects of necessity or of luxury, are unlimited, and the employment of capital is of equal extent with our ability of supplying food and necessaries for the increasing population, which a continually augmenting capital would employ. With every increased difficulty of producing additional supplies of raw produce from the land, corn, and the other necessaries of the labourer, would rise. Hence wages would rise. A real rise of wages is necessarily followed by a real fall of profits, and, therefore, when the land of a country is brought to the highest state of cultivation,—when more labour employed upon it will not yield in return more food than what is necessary to support the labourer so employed, that country is come to the limit of its increase both of capital and population.

The richest country in Europe is yet far distant from that degree of improvement, but if any had arrived at it, by the aid of foreign commerce, even such a country could go on for an indefinite time increasing in wealth and population, for the only obstacle to this increase would be the scarcity, and consequent high value, of food and other raw produce. Let these be supplied from abroad in exchange for manufactured goods, and it is difficult to say where the limit is at which you would cease to accumulate wealth and to derive profit from its employment. This is a question of the utmost importance in political economy. We hope that the little we have said on the subject will be sufficient to induce those who wish clearly to understand the principle, to consult the works of the able authors whom we have named, to which we acknowledge ourselves so much indebted. If these views are correct, there is then no danger that the accumulated capital which a sinking fund, under particular circumstances, might occasion, would not find employment, or that the commodities which it might be made to produce would not be beneficially sold, so as to afford an adequate profit to the producers. On this part of the subject it is only necessary to add, that there would be no necessity for stockholders to become farmers or manufacturers. There are always to be found in a great country, a sufficient number of responsible persons, with the requisite skill, ready to employ the accumulated capital of others, and to pay to them a share of the profits, and which, in all countries, is known by the name of interest for borrowed money.

The second objection to the indefinite increase of the sinking fund remains now to be noticed. By the remission of taxes suddenly to the amount probably of thirty millions *per annum*, a great effect would be produced on the price of goods. "The fate of merchants, manufacturers, mechanics, and every description of dealers, in such an event, must be contemplated by every thinking man with alarm; for should the national debt be discharged, and such a weight of taxation taken off at once, all the goods remain-

ing on hand would be, comparatively speaking, of no value to the holders, because having been purchased or manufactured while such taxation prevailed, they must be undersold by all those who might manufacture the same kind of goods after such taxation had ceased." It is only then on the supposition that merchants, manufacturers, and dealers, would be affected as above described, that any evil would result from the largest remission of taxes. It would not of course be said, that, by remitting a tax of L. 5 to A, L. 10 to B, L. 100 to C, and so on, any injury would be done to them. If they added these different sums to their respective capitals they would augment their permanent annual revenue, and would be contributing to the increase of the mass of commodities, thereby adding to the general abundance. We have already, we hope, successfully shown, that an augmentation of capital is neither injurious to the individual by whom it is saved, nor to the community at large,—its tendency is to increase the demand for labour, and consequently the population, and to add to the power and strength of the country. But they will not add these respective sums to their capitals,—they will expend them as revenue! The measure cannot be said to be either injurious to themselves or to the community on that account. They annually contributed a portion of their produce to the stockholder in payment of debt, who immediately employed it as capital; that portion of produce is now at their own disposal; they may consume it themselves if they please. A farmer who used to sell a portion of his corn for the particular purpose of furnishing this tax, may consume this corn himself,—he may get the distiller to make gin of it, or the brewer to turn it into beer, or he may exchange it for a portion of the cloth which the clothier, who is now released from the tax, as well as the farmer, is at liberty to dispose of for any commodity which he may desire. It may indeed be said, where is all this cloth, beer, gin, &c. to come from; there were no more than necessary for the general demand before this remission of taxes; if every man is now to consume more, from whence is this supply to be obtained? This is an objection of quite an opposite nature to that which was before urged. Now it is said there would be too much demand and no additional supply; before, it was contended that the supply would be so great that no demand would exist for the quantity supplied. One objection is no better founded than the other. The stockholders, by previously receiving the payment of their debt, and employing the funds they received productively, or lending them to some other persons who would so employ them, would produce the very additional commodities which the society at large would have it in their power to consume. There would be a general augmentation of revenue, and a general augmentation of enjoyment, and it must not, for a moment, be supposed that the increased consumption of one part of the people would be at the expence of another part. The good would be unmixed, and without alloy. It remains then only to consider the injury to traders from the fall in the price of goods, and the remedy against this appears to be so very simple, that it surprises us that it should ever have been urged as an objection. In laying on a new tax, the stock in hand of the article taxed is commonly ascertained, and, as a measure of justice, the dealer in such article is required to pay the imposed tax on his stock. Why may not the reverse of this be done? Why may not the tax be returned to each individual on his stock in hand, whenever it shall be thought expedient to take off the tax from the article which he manufactures, or in which he deals? It would only be necessary to continue the taxes for a very short time for this purpose. On no view of this question can we see any validity in the arguments which we have quoted, and which have been so particularly insisted on by Mr Vansittart.

There are some persons who think that a sinking fund, even when strictly applied to its object, is of no national benefit whatever. The money which is contributed, they say, would be more productively employed by the payers of the taxes, than by the Commissioners of the Sinking Fund. The latter purchase stock with it, which probably does not yield 5 *per cent.* the former would obtain from the employment of the same capital much more than 5 *per cent.* consequently the country would be enriched by the difference. There would be in the latter case a larger nett supply of the produce of our land and labour, and that is the fund from which ultimately all our expenditure must be drawn. Those who maintain this opinion, do not see that the commissioners merely receive money from one class of the community and pay it to another class, and that the real question is, Which of these two classes will employ it most productively? Forty millions *per annum* are raised by taxes, of which twenty millions, we will suppose, is paid for sinking fund, and twenty millions for interest of debt. After a year's purchase is made by the commissioners, this forty millions will be divided differently, nineteen millions will be paid for interest, and twenty-one millions for sinking fund, and so from year to year, though forty millions is always paid on the whole, a less and less portion of it will be paid for interest, and a larger portion for sinking fund, till the commissioners have purchased the whole amount of stock, and then the whole forty millions will be in the hands of the commissioners. The sole question then with regard to profits is, Whether those who pay this forty millions, or those who receive it, will employ it most productively?—the commissioners, in fact, never employing it at all, their business being to transfer it to those who will employ it. Now, of this we are quite certain, that all the money received by the stockholder, in return for his stock, must be employed as capital, for if it were not so employed, he would be deprived of his revenue on which he had habitually depended. If then the taxes which are paid towards the sinking fund be derived from the revenue of the country, and not from its capital, by this operation a portion of revenue is yearly realized into capital, and consequently the whole revenue of the society is increased; but it might have been realized into capital by the payer of the tax, if there had been no sinking fund, and he had been allowed to retain the money to his own use! It might so, and if it had

been so disposed of, there can be no advantage in respect to the accumulation of the wealth of the whole society by the establishment of the sinking fund, but it is not so probable that the payer of the tax would make this use of it as the receiver. The receiver when he gets paid for his stock, only substitutes one capital for another,—and he is accustomed to look to his capital for all his yearly income. The payer will have all that he paid in addition to his former revenue; if the sinking fund be discontinued he may indeed realize it into capital, but he may also use it as revenue, increasing his expenditure on wine, houses, horses, clothes, &c. The payer might too have paid it from his capital, and, therefore, the employment of one capital might be substituted for another. In this case too, no advantage arises from the sinking fund, as the national wealth would accumulate as rapidly without it as with it, but if any portion of the taxes paid expressly for the sinking fund be paid from revenue, and which, if not so paid, would have been expended as revenue, then there is a manifest advantage in the sinking fund, as it tends to increase the annual produce of our land and labour, and as we cannot but think that this would be its operation, we are clearly of opinion that a sinking fund, honestly applied, is favourable to the accumulation of wealth.

Dr Hamilton has followed Dr Price in insisting much on the disadvantage of raising loans during war in a 3 *per cent.* stock, and not in a 5 *per cent.* stock. In the former, a great addition is made to the nominal capital, which is generally redeemed, during peace, at a greatly advanced price. Three *per cents.* which were sold at 60, will probably be repurchased at 80, and may come to be bought at 100. Whereas in 5 *per cents.* there would be little or no increase of nominal capital, and as all the stocks are redeemable at par, they would be paid off with very little loss. The correctness of this observation must depend on the relative prices of these two stocks. During the war in 1798, the 3 *per cents.* were at 50, while the 5 *per cents.* were at 73, and at all times the 5 *per cents.* bear a very low relative price to the 3 *per cents.* Here then is one advantage to be put against another, and it must depend upon the degree in which the prices of the 3 *per cents.* and 5 *per cents.* differ, whether it be more desirable to raise the loan in the one or in the other. We have little doubt that, during many periods of the war, there would have been a decided disadvantage in making the loan in 5 *per cent.* stock in preference to a 3 *per cent.* stock. The market in 5 *per cent.* stock, too, is limited, a sale cannot be forced in it without causing a considerable fall, a circumstance known to the contractors, and against which they would naturally take some security in the price which they bid for a large loan if in that stock. A premium of 2 *per cent.* on the market price, may appear to them sufficient to compensate them for their risk in a loan in 3 *per cent.* stock;—they may require one of 5 *per cent.* to protect them against the dangers they apprehend from taking the same loan in a 5 *per cent.* stock.

II. After having duly considered the operation of a sinking fund, derived from annual taxes, we come now to the consideration of the best mode of providing for our annual expenditure, both in war and peace; and, further, to examine whether a country can have any security, that a fund raised for the purpose of paying debt will not be misapplied by ministers, and be really made the instrument for creating new debt, so as never to afford a rational hope that any progress whatever will permanently be made in the reduction of debt.

Suppose a country to be free from debt, and a war to take place, which should involve it in an annual additional expenditure of twenty millions, there are three modes by which this expenditure may be provided; first, taxes may be raised to the amount of twenty millions *per annum*, from which the country would be totally freed on the return of peace; or, secondly, the money might be annually borrowed and funded; in which case, if the interest agreed upon was 5 *per cent.*, a perpetual charge of one million *per annum* taxes would be incurred for the first year's expence, from which there would be no relief during peace, or in any future war; of an additional million for the second year's expence, and so on for every year that the war might last. At the end of twenty years, if the war lasted so long, the country would be perpetually encumbered with taxes of twenty millions *per annum*, and would have to repeat the same course on the recurrence of any new war. The third mode of providing for the expences of the war would be to borrow annually the twenty millions required as before, but to provide, by taxes, a fund, in addition to the interest, which, accumulating at compound interest, should finally be equal to the debt. In the case supposed, if money was raised at 5 *per cent.*, and a sum of L. 200,000 *per annum*, in addition to the million for interest, were provided, it would accumulate to twenty millions in 45 years; and, by consenting to raise L. 1,200,000 *per annum* by taxes, for every loan of twenty millions, each loan would be paid off in 45 years from the time of its creation; and in 45 years from the termination of the war, if no new debt were created, the whole would be redeemed, and the whole of the taxes would be repealed.

Of these three modes, we are decidedly of opinion that the preference should be given to the first. The burthens of the war are undoubtedly great during its continuance, but at its termination they cease altogether. When the pressure of the war is felt at once, without mitigation, we shall be less disposed wantonly to engage in an expensive contest, and if engaged in it, we shall be sooner disposed to get out of it, unless it be a contest for some great national interest. In point of economy, there is no real difference in either of the modes; for twenty millions in one payment, one million *per annum* for ever, or L. 1,200,000 for 45 years, are precisely of the same value; but the people who pay the taxes never so estimate them, and therefore do not manage their private affairs accordingly. We are too apt to think, that the war is burdensome only in proportion to what we are at the moment called to pay for it in taxes, without reflecting on the probable duration of such taxes. It would be difficult to con-

vince a man possessed of L. 20,000, or any other sum, that a perpetual payment of L. 50 *per annum* was equally burdensome with a single tax of L. 1000. He would have some vague notion that the L. 50 *per annum* would be paid by posterity, and would not be paid by him; but if he leaves his fortune to his son, and leaves it charged with this perpetual tax, where is the difference whether he leaves him L. 20,000, with the tax, or L. 19,000 without it? This argument of charging posterity with the interest of our debt, or of relieving them from a portion of such interest, is often used by otherwise well informed people, but we confess we see no weight in it. It may, indeed, be said, that the wealth of the country may increase; and as a portion of the increased wealth will have to contribute to the taxes, the proportion falling on the present amount of wealth will be less, and thus posterity will contribute to our present expenditure. That this may be so is true; but it may also be otherwise—the wealth of the country may diminish—individuals may withdraw from a country heavily taxed; and therefore the property retained in the country may pay more than the just equivalent, which would at the present time be received from it. That an annual tax of L. 50 is not deemed the same in amount as L. 1000 ready money, must have been observed by every body. If an individual were called upon to pay L. 1000 to the income-tax, he would probably endeavour to save the whole of it from his income; he would do no more if, in lieu of this war-tax, a loan had been raised, for the interest of which he would have been called upon to pay only L. 50 income-tax. The war-taxes, then, are more economical; for when they are paid, an effort is made to save to the amount of the whole expenditure of the war, leaving the national capital undiminished. In the other case, an effort is only made to save to the amount of the interest of such expenditure, and therefore the national capital is diminished in amount. The usual objection made to the payment of the larger tax is, that it could not be conveniently paid by manufacturers and landholders, for they have not large sums of money at their command. We think that great efforts would be made to save the tax out of their income, in which case they could obtain the money from this source; but suppose they could not, what should hinder them from selling a part of their property for money, or of borrowing it at interest? That there are persons disposed to lend, is evident from the facility with which government raises its loans. Withdraw this great borrower from the market, and private borrowers would be readily accommodated. By wise regulations, and good laws, the greatest facilities and security might be afforded to individuals in such transactions. In the case of a loan, A advances the money, and B pays the interest, and every thing else remains as before. In the case of war-taxes, A would still advance the money, and B pay the interest, only with this difference, he would pay it directly to A; now he pays it to government, and government pays it to A.

These large taxes, it may be said, must fall on property, which the smaller taxes now do not exclusively do. Those who are in professions, as well as those who live from salaries and wages, and who now contribute annually to the taxes, could not make a large ready money payment; and they would, therefore, be benefited at the expence of the capitalist and landholder. We believe that they would be very little, if at all benefited by the system of war-taxes. Fees to professional men, salaries, and wages, are regulated by the prices of commodities, and by the relative situation of those who pay, and of those who receive them. A tax of the nature proposed, if it did not disturb prices, would, however, change the relation between these classes, and a new arrangement of fees, salaries, and wages, would take place, so that the usual level would be restored.

The reward that is paid to professors, &c. is regulated, like every thing else, by demand and supply. What produces the supply of men, with certain qualifications, is not any particular sum of money, but a certain relative position in society. If you diminished, by additional taxes, the incomes of landlords and capitalists, leaving the pay of professions the same, the relative position of professions would be raised; an additional number of persons would, therefore, be enticed into those lines, and the competition would reduce the pay.

The greatest advantage that would attend war-taxes would be, the little permanent derangement that they would cause to the industry of the country. The prices of our commodities would not be disturbed by taxation, or if they were, they would only be so during a period when every thing is disturbed by other causes, during war. At the commencement of peace, every thing would be at its natural price again, and no inducement would be afforded to us by the direct effect, and still less by the indirect effect of taxes on various commodities, to desert employments in which we have peculiar skill and facilities, and engage in others in which the same skill and facilities are wanting. In a state of freedom every man naturally engages himself in that employment for which he is best fitted, and the greatest abundance of products is the result. An injudicious tax may induce us to import what we should otherwise have produced at home, or to export what we should otherwise have received from abroad; and in both cases, we shall receive, besides the inconvenience of paying the tax, a less return for a given quantity of our labour, than what that labour would, if unfettered, have produced. Under a complicated system of taxation, it is impossible for the wisest legislature to discover all the effects, direct and indirect, of its taxes; and if it cannot do this, the industry of the country will not be exerted to the greatest advantage. By war-taxes, we should save many millions in the collection of taxes. We might get rid of at least some of the expensive establishments, and the army of officers which they employ would be dispensed with. There would be no charges for the management of debt. Loans would not be raised at the rate of L. 50 or L. 60 for a nominal capital of L. 100, to be repaid at L. 70, L. 80, or possibly at L. 100; and perhaps, what is of more importance than all these together, we might get rid of those great sources of the demoralization of the people, the customs and excise. In every view of

this question, we come to the same conclusion, that it would be a great improvement in our system for ever to get rid of the practice of funding. Let us meet our difficulties as they arise, and keep our estates free from permanent incumbrances, of the weight of which we are never truly sensible, till we are involved in them past remedy.

We are now to compare the other two modes of defraying the expences of a war, one by borrowing the capital expended, and providing annual taxes permanently for the payment of the interest, the other by borrowing the capital expended, and besides providing the interest by annual taxes, raising, by the same mode, an additional revenue (and which is called the sinking fund), with a view, within a certain determinate time, to redeem the original debt, and get rid entirely of the taxes.

Under the firm conviction that nations will at last adopt the plan of defraying their expences, ordinary and extraordinary, at the time they are incurred, we are favourable to every plan which shall soonest redeem us from debt; but then we must be convinced that the plan is effective for the object. This then is the place to examine whether we have, or can have, any security for the due application of the sinking fund to the payment of debt.

When Mr Pitt, in 1786, established the sinking fund, he was aware of the danger of entrusting it to ministers and parliament; and, therefore, provided that the sums applicable to the sinking fund should be paid by the Exchequer into the hands of commissioners, by quarterly payments, who should be required to invest equal sums of money in the purchase of stock, on four days in each week, or about fifty days in each quarter. The commissioners named were, the Speaker of the House of Commons, the Chancellor of the Exchequer, the Master of the Rolls, the Accountant General of the Court of Chancery, and the Governor and Deputy-Governor of the Bank. He thought, that, under such management, there could be no misapplication of the funds, and he thought correctly, for the commissioners have faithfully fulfilled the trust reposed in them. In proposing the establishment of a sinking fund to Parliament in 1786, Mr Pitt said, " With regard to preserving the fund to be invariably applied to the diminution of the debt inalienable, it was the essence of his plan to keep that sacred, and most effectually so in time of war. He must contend, that to suffer the fund at any time, or on any pretence, to be diverted from its proper object, would be to ruin, defeat, and overturn his plan. He hoped, therefore, when the bill he should introduce should pass into a law, that House would hold itself solemnly pledged, not to listen to a proposal for its repeal on any pretence whatever."

" If this million, to be so applied, is laid out with its growing interest, it will amount to a very great sum in a period that is not very long in the life of an individual, and but an hour in the existence of a great nation; and this will diminish the debt of this country so much, as to prevent the exigencies of war from raising it to the enormous height it has hitherto done. In the period of twenty-eight years, the sum of a million, annually improved, would amount to four millions *per annum,* but care must be taken that this fund be not broken in upon; *this has hitherto been the bane of this country;* for if the original sinking fund had been properly preserved, it is easy to be proved that our debts, at this moment, would not have been very burthensome; *this has hitherto been, in vain, endeavoured to be prevented by acts of Parliament;* the minister has uniformly, when it suited his convenience, gotten hold of this sum, which ought to have been regarded as most sacred. What then is the way of preventing this? The plan I mean to propose is this, that this sum be vested in certain commissioners, to be by them applied quarterly to buy up stock; by this means, no sum so great will ever be ready to be seized upon on any occasion, and the fund will go on without interruption. Long and very long has this country struggled under its heavy load, without any prospect of being relieved; but it may now look forward to an object upon which the existence of this country depends; it is, therefore, proper it should be fortified as much as possible against alienation. By this manner of paying L.250,000 quarterly into the hands of commissioners, it would make it impossible to take it by stealth; and the advantage would be too well felt ever to suffer a public act for that purpose. A minister could not have the confidence to come to this House, and desire the repeal of so beneficial a law, which tended so directly to relieve the people from burthen."

Mr Pitt flattered himself most strangely, that he had found a remedy for the difficulty which " had hitherto been the bane of this country;" he thought he had discovered means for preventing " ministers, when it suited their convenience, from getting hold of this sum, which ought to be regarded as most sacred." With the knowledge of Parliament which he had, it is surprising that he should have relied so firmly on the resistance which the House of Commons would offer to any plan of ministers for violating the sinking fund. Ministers have never desired the partial repeal of this law, without obtaining a ready compliance from Parliament.

We have already shown, that, in 1807, one Chancellor of the Exchequer proposed to relieve the country from taxation, with a very slight exception, for several years together, while we were, during war, keeping up, if not increasing our expenditure, and supplying it by means of annual loans. What is this but disposing of a fund which ought to have been regarded as most sacred?

In 1809, another Chancellor of the Exchequer raised a loan, without raising any additional taxes to pay the interest of it, but pledged a portion of the war taxes for that purpose, thereby rendering an addition to that amount, necessary to the loan of the following and every succeeding year. Was not this disposing of the sinking fund by stealth, and accumulating debt at compound interest? Another Chancellor of the Exchequer, in 1813, proposed a partial repeal of the law, by which seven millions *per annum* of the sinking fund was placed at his disposal, and which he has employed in providing for the interest of new debt. This was done with the sanc-

tion of Parliament, and, as we apprehend, in direct violation of all the laws which had before been passed regarding the sinking fund. But what has become of the remainder of this fund, after deducting the seven millions taken from it by the act of 1813? It should now be sixteen millions, and at that amount it was returned in the annual finance accounts last laid before Parliament. The finance committee appointed by the House of Commons did not fail to see that nothing can be deemed an efficient fund for the redemption of debt in time of peace, but such as arises from an excess of revenue above expenditure, and as that excess, under the most favourable view, was not quite two millions, they considered that sum as the real efficient sinking fund, which was now applicable to the discharge of debt. If the act of 1802 had been complied with, if the intentions of Mr Pitt had been fulfilled, we should now have had a clear excess of revenue of above twenty millions, applicable to the payment of the debt; as it is, we have two millions only, and if we ask ministers what has become of the remaining eighteen millions, they show us an expensive peace establishment, which they have no other means of defraying but by drafts on this fund, or several hundred millions of 3 *per cents.* on which it is employed in discharging the interest. If ministers had not had such an amount of taxes to depend on, would they have ventured, year after year, to encounter a deficiency of revenue below expenditure, for several years together, of more than twelve millions? It is true that the measures of Mr Pitt locked it up from their immediate seizure, but they knew it was in the hands of the commissioners, and presumed as much upon it, and justly, with the knowledge they had of Parliament, as if it had been in their own. They considered the commissioners as their trustees, accumulating money for their benefit, and of which they knew that they might dispose whenever they should consider that the urgency of the case required it. They seem to have made a tacit agreement with the commissioners, that they should accumulate twelve millions *per annum* at compound interest, while they themselves accumulated an equal amount of debt, also at compound interest. The facts are indeed no longer denied. In the last session of Parliament, for the first time the delusion was acknowledged by ministers, after it had become manifest to every other person; but yet it is avowed to be their intention, to go on with this nominal sinking fund, raising a loan every year for the difference between its real and nominal amount, and letting the commissioners subscribe to it. On what principle this can be done, it would be difficult to give any rational account. Perhaps it may be said, that it would be a breach of faith to the stockholder to take away the sinking fund, but is it not equally a breach of faith if the Government itself sells to the commissioners the greatest part of the stock which they buy? The stockholder wants something substantial and real to be done for him, and not any thing deceitful and delusive. Disguise it as you will, if of fourteen millions to be invested by the commissioners in time of peace, the stock which twelve millions will purchase is sold by the Government itself, which creates it for the very purpose of obtaining these twelve millions, and only stock for two millions is purchased in the market, and no taxes for sinking fund or interest are provided for the twelve millions which Government takes; the result is precisely the same to the stockholder, and to every one concerned, as if the sinking fund was reduced to two millions. It is utterly unworthy of a great country to countenance such pitiful shifts and evasions.

The sinking fund, then, has, instead of diminishing the debt, greatly increased it. The sinking fund has encouraged expenditure. If, during war, a country spends twenty millions *per annum*, in addition to its ordinary expenditure, and raises taxes only for the interest, it will, in twenty years, accumulate a debt of four hundred millions; and its taxes will increase to twenty millions *per annum*. If, in addition to the million *per annum*, taxes of L.200,000 were raised for a sinking fund, and regularly applied to the purchase of stock, the taxes, at the end of twenty years, would be twenty-four millions, and its debt only 342 millions; for fifty-eight millions will have been paid off by the sinking fund; but if, at the end of this period, new debt shall be contracted, and the sinking fund itself, with all its accumulations, amounting to L.6,940,000, be absorbed in the payment of interest on such debt, the whole amount of debt will be 538 millions, exceeding that which would have existed if there had been no sinking fund by 138 millions. If such an additional expenditure were necessary, provision should be made for it without any interference with the sinking fund. If, at the end of the war, there is not a clear surplus of revenue above expenditure of L. 6,940,000, on the above supposition, there is no use whatever in persevering in a system which is so little adequate to its object. After all our experience, however, we are again toiling to raise a sinking fund; and, in the last session of Parliament, three millions of new taxes were voted, with the avowed object of raising the remnant of our sinking fund, now reduced to two millions, to five millions. Is it rash to prognosticate that this sinking fund will share the fate of all those which have preceded it? Probably it will accumulate for a few years, till we are engaged in some new contest, when ministers, finding it difficult to raise taxes for the interest of loans, will silently encroach on this fund, and we shall be fortunate if, in their next arrangement, we shall be able to preserve out of its wreck an amount so large as two millions.

It is, we think, sufficiently proved, that no securities can be given by ministers that the sinking fund shall be faithfully devoted to the payment of debt, and without such securities we should be much better without such a fund. To pay off the whole, or a great portion of our debt, is, in our estimation, a most desirable object; if, at the same time, we acknowledged the evils of the funding system, and resolutely determined to carry on our future contests without having recourse to it. This cannot, or rather will not, be done by a sinking fund as at present constituted, nor by any other that we can suggest; but if, without raising any fund, the debt were paid by a tax on property, once for all, it would ef-

fect its object. Its operation might be completed in two or three years during peace; and, if we mean honestly to discharge the debt, we do not see any other mode of accomplishing it. The objections to this plan are the same as those which we have already attempted to answer in speaking of war taxes. The stockholders being paid off, would have a large mass of property, for which they would be eagerly seeking employment. Manufacturers and landholders would want large sums for their payments into the Exchequer. These two parties would not fail to make an arrangement with each other, by which one party would employ their money, and the other raise it. They might do this by loan, or by sale and purchase, as they might think it most conducive to their respective interests; with this the state would have nothing to do. Thus, by one great effort, we should get rid of one of the most terrible scourges which was ever invented to afflict a nation; and our commerce would be extended without being subject to all the vexatious delays and interruptions which our present artificial system imposes upon it.

There cannot be a greater security for the continuance of peace than the imposing on ministers the necessity of applying to the people for taxes to support a war. Suffer the sinking fund to accumulate during peace to any considerable sum, and very little provocation would induce them to enter into a new contest. They would know that, by a little management, they could make the sinking fund available to the raising of a new supply, instead of being available to the payment of the debt. The argument is now common in the mouths of ministers when they wish to lay on new taxes, for the purpose of creating a new sinking fund, in lieu of one which they have just spent, to say, "It will make foreign countries respect us; they will be afraid to insult or provoke us, when they know that we are possessed of so powerful a resource." What do they mean by this argument, if the sinking fund be not considered by them as a war fund, on which they can draw in support of the contest? It cannot, at one and the same time, be employed in the annoyance of an enemy, and in the payment of debt. If taxes are, as they ought to be, raised for the expences of a war, what facility will a sinking fund give to the raising of them? none whatever. It is not because the possession of a sinking fund will enable them to raise new and additional taxes that ministers prize it; for they know it will have no such effect; but because they know that they will be enabled to substitute the sinking fund in lieu of taxes, and employ it, as they have always done, in war, and providing interest for fresh debt. Their argument means this, or it means nothing; for a sinking fund does not necessarily add to the wealth and prosperity of a country; and it is on that wealth and prosperity that it must depend whether new burthens can be borne by the people. What did Mr Vansittart mean in 1813, when he said that "the advantage which his new plan of finance would hereafter give, in furnishing 100 millions in time of peace, as a fund against the return of hostilities, was one of great moment. This would place an instrument of force in the hands of parliament which might lead to the most important results." "It might be objected by some, that, keeping in reserve a large fund to meet the expences of a new war, might be likely to make the government of this country arrogant and ambitious; and therefore have a tendency unnecessarily to plunge us in new contests;"—not a very unreasonable objection, we should think! How does Mr Vansittart answer it? "On this subject he would say from long experience and observation, that it would be better for our neighbours to depend on the moderation of this country, than for this country to depend on them. He should not think the plan objectionable on this account. If the sums treasured up were misapplied by the arrogant or ambitious conduct of our government, the blame must fall on the heads of those who misused it, not on those who put it into their hands for purposes of defence. They did their duty in furnishing the means of preserving the greatness and glory of the country, though those means might be used for the purposes of ambition, rapine, and desolation." These are very natural observations from the mouth of a minister; but we are of opinion that such a treasure would be more safe in the custody of the people, and that Parliament have something more to do than to furnish ministers with the means of preserving the greatness and glory of the country. It is their duty to take every security that the resources of the country are not misapplied "by the arrogant and ambitious conduct of our government," or "used for the purposes of ambition, rapine, and desolation."

If we had no other reason for our opinion, this speech would convince us that, in the present constitution of Parliament, the superintending authority, the sinking fund is pernicious, and that it cannot be too soon abolished.

On the extraordinary assumption that there was any thing in Mr Vansittart's plan that would, more effectually than the old plan, allow 100 millions hereafter to be appropriated to the public service, Dr Hamilton has the following observations:

"We are altogether at a loss to form a distinct conception of the *valuable treasure* here held forth. So soon as any stock is purchased by the commissioners, and stands invested in their name, a like amount of the public debt is in fact discharged. Whether a Parliamentary declaration to the effect be made or not, is only a matter of form. If the money remain invested in the name of the commissioners, no doubt it may be transferred again to purchasers in the stock exchange, when war broke out anew; and money may be raised for the public in this manner. It is an application to the public to invest their capital in the purchase of this dormant stock." "It is true, that, if the taxes imposed during war, for the purpose of a sinking fund, be continued after peace is restored, till a large sum (suppose L.100,000,000) be vested in the hands of the Commissioners, the public, upon the renewal of the war, may spend to that amount without imposing fresh taxes, an advantage," observes Mr Huskisson, "not only not exclusively belonging to this plan, but unavoidable under any plan of a sinking fund in time of peace." Mr Vansittart ought to have said,

"if our sinking fund should accumulate, in time of peace, to so large a sum that I can take five millions *per annum* from it; I can spend L.100,000,000 in a new war without coming to you for fresh taxes; the disadvantages of my plan are, that by now taking L.7,000,000 *per annum* from it, and making a provision for speedily, and at regular intervals, appropriating more of this fund to present objects, the sinking fund will be so much diminished, that I cannot so soon, by a great many years, avail myself of the five millions for the purpose which I have stated." (E. E. E.)

Funding System || Galiani.

GAL

GALIANI (FERDINAND), an eminent Italian writer, was born at Chieti, in the Neapolitan province of Abbruzzo, on the 2d of December 1728. At eight years of age, he was sent to his uncle at Naples, who was then first chaplain to the King. Here he received his elementary education, along with his brother, Bernard, who was a few years older. In 1740, the uncle being obliged to go to Rome, upon a political mission, he gave his two nephews in charge to the Celestine fathers, for the continuance of their studies; and accordingly, in the course of two years, they were instructed in philosophy, the mathematics, and other liberal sciences. The archbishop, on his return to Naples, received them back into his palace, where they studied law, and enjoyed the society and conversation of the most distinguished professors of the University of Naples. Ferdinand, who possessed great talents and vivacity, devoted himself with ardour to the study of history, antiquities, the *Belles Lettres*, and philosophy, and more particularly to political economy. At the age of sixteen, he produced a *Memoir on the Coins of the period of the Trojan War;* and this early production first inspired him with the idea of his great work on money. He also translated Locke's treatise on *Money and Interest.* At the age of eighteen, he undertook a work on the *Ancient History of the Navigation of the Mediterranean;* and in his great work, we find that he there made use of a part of the materials which he had collected at this early age. A *jeu d'esprit,* which had nearly been attended with serious consequences, diverted him, for some time, from his graver studies. Having been charged by his brother, Bernard, to deliver, in his absence, a discourse in an Academy, of which he was a member; the president, looking only at the youth of Ferdinand, and being ignorant of his talents, would not permit him to proceed. The latter resolved to revenge himself in a manner that showed more spirit than prudence. It was the custom in this Academy, as in several others, that when any great personage died at Naples, all the academicians published, in his praise, a collection of pieces in prose and verse. The executioner at Naples having died, Galiani seized the opportunity of turning the Academy into ridicule. With the assistance of a friend, he composed, in the course of a few days, a collection of serious pieces on this event, which were ascribed to each of the members, and in which their peculiar style and manner were so well imitated, that one of them confessed he should have been himself deceived, if he had not been perfectly certain that he had not written the piece to which his name was subscribed. This malicious and witty little volume appeared in 1749, under the title of *Componimenti varj per la Morte di Domenico Jannacone, Carnefice della gran corte della vicaria, raccolti e dati in luce da Gian. Anton. Sergio Avvocato Napoletano.* This Sergio was the president of the Academy. The publication was eminently successful, and excited a sensation which the authors had not foreseen; and as they became afraid of being discovered by the publisher, they went directly to the minister Tanucci, confessed the fact, and got off for the performance of some spiritual exercises.

Galiani soon effaced the impression made by this piece of youthful folly, by the publication of his *Treatise on Money,* which had employed the labour of several years. It appeared at Naples in 1750, when the author was only twenty-one. It was first published anonymously, and the author did not make himself known until the success of the work was decided. The Archbishop of Tarentum took this occasion to patronize him, and procured for him several benefices, which induced him to take orders. He afterwards travelled through the whole of Italy, was presented at the various courts, and found himself every where preceded by his reputation. He was well received by the Pope, and several of the Italian princes, was admitted a member of some of the most celebrated Academies, and established a correspondence with many of the most eminent literary characters. His next publication was a treatise, entitled, *Della perfetta Conservazione del Grano,* written, with his usual elegance, for the purpose of recommending an ingenious machine, invented by his friend Intieri, for drying and preserving grain.

The active mind of Galiani was now engaged in investigating several scientific subjects, particularly connected with antiquities and natural history. He was the first who undertook to form a collection of the volcanic productions of Vesuvius; and he wrote a learned treatise upon this subject, which, however, was not printed until fifteen years afterwards. He presented the manuscript to Pope Benedict XIV. along with the collection itself, which was arranged in seven boxes, according to the order

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of the treatise. The collection was placed in the Museum of the Institute of Bologna, where it still remains. In presenting this collection to the Pope, Galiani had written upon one of the boxes:—*Beatissime Pater, fac ut lapides isti panes fiant.* His holiness, understanding the hint, gave him the prebend of Amalfi, worth 400 ducats a-year. In the lifetime of his uncle, whom he lost in 1753, he enjoyed a benefice of 500 ducats, which conferred upon him the episcopal dignity, and another living worth 600 ducats. His funeral oration, on the death of his patron, Benedict XIV., who died in 1758, procured him a high character for eloquence, and was one of his works which he himself most esteemed.

Galiani was one of the members of the Academy of Herculaneum, established by King Charles III. for the purpose of illustrating the remains of ancient art, discovered among the ruins of that city; and he furnished several memoirs, which were inserted in the first volume of that magnificent work, the *Antiquities of Herculaneum.* With the other academicians who were engaged in this labour, Galiani enjoyed the royal bounty, in a pension of 250 ducats.

In the month of January 1759, he was appointed Secretary of State, and of the royal household, and, soon afterwards, Secretary to the French embassy; and he arrived at Paris in the month of June following. Here his reception was exceedingly flattering, and his company was courted in all polite literary societies. The ambassador was the Count Cantillano, Marquis of Castromonte, a Spanish nobleman, of much indolence and little talent. During the absence of the Count, on a six months' journey to Spain, Galiani remained *chargé d'affaires*, was presented to the King of France, and enjoyed all the advantages of his situation. He applied himself with great zeal and assiduity to the acquisition of a correct French style of writing; and about this time, he commenced his learned and ingenious *Commentary on Horace*, of which the Abbé Arnaud inserted some extracts in the 5th, 6th, and 7th volumes of his *Gazette Litteraire* for 1765. About the commencement of that year Galiani had set out for Naples, for the purpose of taking the waters of Ischia. Long after his period of leave had expired, he was retained by the government, employed and consulted in several matters of importance, and at length appointed a Member of the Supreme Council of Commerce. With this new title he returned to Paris; and about a year afterwards he obtained permission to travel for a few months in England, having been invited to that country by the Marquis of Caracciolo, who was then Ambassador from the court of Naples at London. He returned through Holland to Paris, and soon afterwards wrote in French his celebrated *Dialogues sur le Commerce des Blés;* the style of which is so easy and elegant, that one would never suppose it to be the work of a foreigner. The manuscript was left in the hands of Diderot, and was published in 1770, with the date of London, and without the name of the author. The work excited great attention in France, and the best writers were loud and unanimous in their praise of it. Voltaire wrote to Diderot, who had sent him a copy, in the following terms: "The powers of Plato and Moliere seem to be combined in the composition of this work. I have as yet only read about two-thirds of it; and I expect the *denouement* of the piece with great impatience." The same author again praises the work in his *Questions sur l'Encyclopedié*, in the article *Bled ou Blé.*

Galiani.

Meanwhile, Galiani had returned to Naples, where, in addition to his office of a Member of the Council of Commerce, he received that of Secretary to the same tribunal. These two situations brought him a revenue of 1600 ducats. In 1777, he was made one of the ministers of the *junto* of the royal domains, who had the charge of every thing connected with the private patrimony of the King; an office which added 200 ducats to his income. His partiality for the writings of Horace inspired him with the idea of a treatise *Des instincts ou des gouts naturels et des habitudes de l'homme, ou Principes du droit de la nature et des gens, tirés des Poësies d'Horace;* a work which he left nearly complete, but which has never been published. There is a life of Horace prefixed, much better and more complete than that which is inserted in the works of Algarotti. The project which he entertained, of a dramatic Academy, induced him to attempt the composition of a comic opera, in a new and singular style. This was *The Imaginary Socrates*, of which he gave the plan to the poet Lorenzi, who put it into verse, and it was set to music by the celebrated Paisiello. The piece was performed with the greatest success throughout Italy, Germany, and even at St Petersburgh. Galiani himself was passionately fond of music. He sung agreeably, and played well on the harpsichord. His library was select rather than numerous, and particularly rich in good editions of the Greek and Latin classics. He had also a considerable and very valuable cabinet of ancient coins and rare medals, engraved stones, cameos, and a few statues.

On the 8th of August 1779, a terrible eruption of Vesuvius spread the utmost dismay throughout Naples. For some time the press teemed with new and frightful descriptions of this phenomenon, and the ravages it occasioned; and the minds of the inhabitants were every day filled with fresh terror. In order to efface these disagreeable impressions, Galiani, in a single night, composed a piece upon this eruption, in which he imitated very happily the style of an author who was well known in the city for his ridiculous weakness. This production was printed next day, under the following title: *Spaventosissima descrizione dello spaventoso spavento, che ci spavento tutti coll' eruzione delli* 8 *di Agosto del corrente anno, ma (per grazia di Dio) duro poco, di D. Onofrio Galeota, poeta e filosofo all' impronto.* It was a very laughable piece, on a very serious subject; and it had the effect of dispelling the melancholy ideas which had got possession of the minds of the people.

Galiani was very fond of the Neapolitan dialect, and took great pleasure in speaking it. In the same year, he published anonymously, as was his custom, a work entitled, *Del dialetto Napolitano;* in which he gave, for the first time, a grammar and history of this dialect, which, he maintained, was the primitive

language of Italy; and shortly afterwards he composed a lexicon of the words peculiar to the Neapolitan tongue, which was begun to be printed in 1780; but the work was suspended, and has not since been resumed.

A work of a different kind soon afterwards engaged his attention. In the war which broke out in 1788, between England on one side, and France and Spain on the other, Naples and some other powers had remained neutral; but their rights, as they conceived, were not sufficiently respected by the belligerent parties. Numerous writings appeared throughout Europe, on the rights and duties of neutrals; and, among others, Galiani produced a Treatise, in Italian, *On the Duties of Neutrals towards Belligerent Powers, and of the latter towards the former.* It was published at Naples in 1782, in 4to. In the same year, he was appointed first Assessor to the General Council of Finance; a situation which he accepted the more readily, as its duties were analogous to his other studies; but he refused to touch the salary. A few months afterwards, however, the King presented him with the Abbacy of Scurcoli, which was worth 1200 ducats *per annum,* after deducting all charges and pensions. The office of Assessor of Economy in the superintendence of the crown funds, to which he was appointed in 1784, added to his public duties, and likewise increased his income. Meanwhile, his health, which was naturally weak, declined daily. On the 13th of May 1785, he had an attack of apoplexy; and, in order to prevent a return, he travelled, the following year, through Puglia. In 1787, he made a longer journey, and went as far as Venice, where he was well received by all the men of letters, as he was also at Modena by Tiraboschi, and by Cesarotti at Padua. On his return to Naples, his health rapidly declined; and he died, quietly and resignedly, on the 30th of October 1787, at the age of fifty-nine.

Besides the works already mentioned, Galiani left behind him a variety of interesting manuscripts, which came into the possession of D. Francesco Azzariti, his heir, and many of which, it is said, well deserve publication. Among them are, 1. *The Commentary on Horace, with the Life.* 2. *The Lexicon of Words peculiar to the Neapolitan Dialect.* 3. *A Poetical Translation of the Anti-Lucretius.* 4. *A Miscellaneous Collection of Poetical Pieces.* 5. Several Volumes full of facetious *Letters, Novels, and Anecdotes.* 6. *His Epistolary Correspondence,* which would form, of itself, a pretty voluminous collection. A part of it was published at Paris in 1818, in 2 vols. 8vo.

See the article Galiani, by Ginguené, in the *Biographie Universelle,* Tom. XVI.

(H.)

GALVANISM.

The article Galvanism, in the *Encyclopædia,* contains a detailed exposition of a great number of facts, relative to this new and interesting branch of physics. Since the time it appears to have been written, various remarkable phenomena have been brought to light by means of the Voltaic apparatus; and it appears to us, that we are now enabled, as well by the extension of knowledge thence resulting, as by the more profound discussion of the Galvanic action itself, to place its theory in a clearer and more determinate point of view, and to combine, in a more philosophical manner, a number of facts, of which a too confined examination had led to inconsistent and contradictory conclusions. Such is the principal object of the supplementary article which we now offer to our readers.

It seems, first of all, indispensable to establish, with a little more precision, some historical details regarding the order in which the discoveries of Galvani and of Volta were made. Most authors who have written on this subject mention the origin of the discovery of Galvani, and the accident of his observing convulsions in the muscles of frogs exposed at some distance from an electrical machine, from which he was drawing sparks. This appearance was, in fact, the first which he observed; and it was the astonishment which it excited that induced him to vary the circumstances of the experiment in every possible manner. He was thus led to perceive, that convulsions were produced in the dead bodies of frogs, apparently without the intervention of any external electrical agent; for this effect took place when the lumbar nerves having been laid bare, and connected together by a hook of copper, were suspended by this hook to a balcony of iron, with the rails of which the muscles of the thighs came in contact by their own weight. (Fig. 1, Plate LXXX.*) But although the first of these observations gave rise to the other, their succession is purely accidental, as they have not the slightest relation to each other. The convulsions excited in the dead bodies of frogs, placed near an electrical machine, form a very simple and ordinary occurrence. On turning the plate or cylinder of the machine, a certain quantity of free electricity is developed by the friction, and spreads itself over the adjacent conductor. This electricity, acting on all the surrounding bodies, decomposes their natural electricities, attracts that of the opposite kind, and repels the other, which escapes into the ground, if any communication exists by which it can discharge itself. If the electricity, thus attracted by the machine, is not powerful enough to escape from the bodies by explosion through the air, it remains in them neutralized by the action at a distance.* But if we suddenly draw from the machine a spark which discharges it for a mo-

* It may be necessary to remark, that the reasonings and illustrations of the writer of this article

 ment, this action ceases; the electricity of the same kind which had been repelled into the ground, returns instantly to unite with the opposite kind; and its quick passage excites contractions in the muscular organs of the animal. But, since the suspension of the animal by a hook of copper to a railing of iron also produces contractions in these muscles at the moment of contact, is it not natural to imagine that these convulsions are produced by the accidental developement of some electrical current, which this contact occasions? This, however, was not Galvani's conclusion. He chose, rather, to view these motions as the unexpected effect of a particular source of electricity, having its seat in the nerves and muscles; and the action of which he vainly attempted to assimilate with that of the Leyden phial. But, in reading the work where Galvani has explained this hypothesis, entitled, *De viribus electricitatis in motu musculari commentarius,* we easily perceive, that he had no idea of the true theory of the electrical influences; and, as he has allowed himself to be carried away by hypothetical ideas, we are the more led to admire the rare sagacity by which he has been able to detect, and to vary with so much art, the extraordinary phenomenon of convulsions apparently spontaneous, and which chance had presented to his view.

The connection of these phenomena with those which an electric current produces in passing through our organs, could not escape so able an electrician as Volta; and it may be said, that chance itself, in making them succeed to the sensible effects of the influences of artificial electricity, had as it were taken care to indicate their true source by this resemblance. Volta, accordingly, did not hesitate concerning their nature; but, conceiving that the exciting cause of these movements, whatever it was, must be extremely subtile, since it had been produced independently of the will, even of the observer, he began to examine what precise quantity of electricity was necessary to excite convulsions in the organs of a frog, by sending discharges through them. He thus found that this quantity was so extremely inconsiderable, that it was scarcely sufficient to make the leaves or threads of the delicate electrometer he made use of to diverge sensibly. This result being well established, he compared it with the other fact, established by the experiments of Galvani, that the contact of two or more metals, of different kinds, was, or at least at that time seemed to be, necessary for the excitation of convulsions; and he drew this conclusion, that the contact of these different kinds of metals was the real circumstance, though previously unnoticed, which determined the sudden developement of electricity. Following out this truly fundamental idea, Volta collected under one point of view all the experiments made by Galvani; pointed out the methods of repeating them with certain effect, and with the highest degree of energy of which they were susceptible; and, lastly, joined to them several phenomena of animal sensation, to which sufficient attention had not as yet been paid, undoubtedly on account of their being quite separated from the other facts already known; but which, rightly examined, also bore the most evident relation to the irritating action excited in the living organs by the mutual contact of several metals.

Galvani endeavoured to maintain his opinion of an animal electricity in opposition to the Professor of Pavia; objecting to him the convulsions excited by an arc of a single metal, and trying to vary the circumstances of this case. After having, for example, quickly prepared a frog, as described above, if we throw it immediately into a vessel of mercury well cleaned, so that it may touch the metal with the muscles of its thighs, and with the lumbar nerves, it will commonly exhibit convulsions. Volta replied, that, even in this case, there might have been something heterogeneous in the different parts of the conducting arc, either lying on the surface of the mercury itself, or produced by the contact of the metals employed in preparing the animal. In reality, the slightest differences in the substances employed to form the chain, are sufficient to excite convulsions which were not produced before. If we cover, for example, the lumbar nerves of the frog with a coating of impure lead, such as is used by glaziers, and complete the communication with the thighs by an arc of the same metal taken from the same sheet, and consequently of a nature exactly similar, we shall scarcely produce any effects; but if we establish the communication with purified lead, such as is used by assayers, the covering of the nerves remaining the same, the convulsions immediately begin to appear; and it is even sufficient to rub the arc of a single metal against another metal, to communicate to it a nature sufficiently heterogeneous. Galvani, however, did not as yet accede to these remarks. He even carried his doubts so far as to prepare the organs of the frog with thin and sharp-edged plates of glass,—he still obtained convulsions by an arc of a single metal, but only soon after the death of the animal, and when the irritability was extremely powerful. Lastly, after having prepared the frog with all those precautions, he succeeded in producing contractions by the mere contact of the muscles of the thighs and of the lumbar nerves of the animal itself, without using any other substance whatever to complete the conducting arc. But if, as Volta said, and as we shall afterwards prove, electricity be developed by the mere contact of two metals, it is possible that it may be developed by the contact of any two heterogeneous substances whatever, such as muscles and nerves. If the action be much feebler than that of metal on metal, it is necessary, in order to show it, to employ an electrometer of still greater sensibility, and such as the organs of the frog appear to be immediately after death. The new fact ob-

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proceed uniformly on the theory of two electrical fluids existing naturally in all bodies, and in ordinary cases, disguising each other's effect by a kind of mutual neutralization. See the article Electricity in this *Supplement*.

served by Galvani, therefore, although extremely remarkable, so far from overturning the idea of Volta, only renders it more general.

It was desirable, however, to establish this idea by substantial proofs, and this Volta has done by a series of experiments, repeated by himself in presence of a Commission of the members of the Institute of France, and which have since been invariably confirmed, as well by the members of this Commission as by a number of other philosophers. As these experiments are much simpler and more easily executed than those treated of in the article GALVANISM, which were made with Nicholson's *Doubler*; and as the publicity then given to them furnishes a reply to the suspicions which had been thrown out in several esteemed works, we shall here give a short abridgment of them. *

In these experiments Volta employed two metallic discs, the one of zinc, the other of copper, two, or two and one-half inches in breadth, very plane, not varnished, and having in their centres insulating handles perpendicular to their surfaces, by means of which he could bring them into contact with each other without actually touching any of them with the hand. In this manner he made these discs approach until they touched each other, as in fig. 2, Plate LXXXI. * and then separated them, keeping them parallel as he drew them back; but as the electricity developed by a single contact is always extremely feeble, he did not immediately try it with the electrometer. He armed it with a little condenser, fig. 3, in which he accumulated the electricity of several contacts, by making its upper plate communicate with the ground, and with the metallic disc whose electricity he wished to estimate, touching the under plate, which communicated with the leaves of the electrometer. This being done, he drew back the metallic disc, and touched it as well as the other in order to restore them both to their natural state; he then brought them again insulated into contact, again separated them, and applied to the condenser the one under examination. After seven or eight contacts of this kind, on raising the upper plate of the condenser the leaves diverged very much, in consequence of the electricity deposited in the under plate by the successive contacts of the metallic disc; and he was hence enabled to determine the nature of this electricity.

In the case, for example, of the two discs of copper or zinc, if it is the copper disc which touches the under plate of the electrometer, the electricity which makes the leaves diverge is resinous; if we touch it with the zinc it is vitreous: thus these two metals, insulated and in the natural state, are brought by their simple contact into different electrical states; the zinc acquiring an excess of vitreous electricity, and the copper the complementary excess of resinous electricity. For the success of the experiment, it is useful, that the metallic surface of the condenser be covered, at the point of contact, with a small leaf of paper, to prevent any new contact of metal with metal on the condensing plates.

We may repeat this experiment in a different manner. Instead of making one of the plates of the condenser communicate with the ground, leave them both insulated upon the electrometer; but every time that the two discs of contact are separated, touch with each of them, and always with the same, each of the plates of the condenser, covered, at the point of contact, with a leaf of paper. As the free electricities which they possess are of a contrary nature, they will mutually attract each other, and attach themselves to the contiguous surfaces of the plates. After several contacts of this kind, separate the plates, and each of them will be found charged with that species of electricity belonging to the plate with which it was touched.

It might be imagined that the electricity which is produced in these circumstances, is owing to a sort of compression of the plates against each other, like that which arises when we press gummed taffeta against a metallic plate. But it is easy to prove that the action which is developed during the contact of metals is quite of a different kind, and is excited by a reciprocal influence which decomposes their natural electricities. To establish this capital fact, Volta made the following experiment: He formed a thin metallic plate with two pieces, C, Z, fig. 4, the one Z of zinc, the other C of copper, soldered end to end; then taking between the fingers the extremity Z, composed of zinc, he touched with the copper extremity the upper plate of a condenser, which is also of copper, and the under plate of which communicated with the ground. After the contact, the plate, which has been touched, was found to be electrified resinously. This is entirely conformable to the preceding experiments; only we need not here apprehend any compression or any separation between the mollecules of zinc and those of copper, since their juxtaposition is permanently established, and the contact upon the condenser takes place between copper and copper, which cannot develope any new electricity: in order that the electricity thus produced by a single contact may be very apparent, the condenser must be much larger than that of the electrometer, and its condensing power considerable.

We may still obtain similar effects without touching the plate of zinc with the fingers, but merely by holding it between sticks of glass, or of any other insulating substance. But as this plate now communicates no more with the ground, it must be brought in contact with some body of a great capacity, from which it may receive the electricity to furnish to the collecting plate of the condenser. This is

* The author of this article was himself a witness to those experiments; he formed one of the Commission of the Institute appointed to examine them; and was also entrusted with the drawing up of the *Report* which was adopted by that body.

done, either by using a plate of zinc of a large surface, or what is still better, by making it touch the inside of a large Leyden jar, coated within with a leaf of zinc, and of which the external surface, coated also with the same metal, is in communication with the ground.

This experiment being finished, repeat it in a reverse order. Take between the fingers that extremity C of the plate which is of copper, and touch with the zinc extremity the upper plate of the condenser, which is also of copper. Fig. 5, Plate LXXXI.* When we put an end to this contact, and raise up the plate which was applied to the condenser, it does not acquire any electricity, although the inferior plate communicates with the ground. In this experiment, nevertheless, the copper and the zinc still communicate together, and still touch eachother as at first; the only difference consists in this, that the two pieces of copper, which communicate with the zinc, were then placed end to end, while, in the second experiment, they were placed between the opposite ends of the zinc. Whatever be the cause, then, which developes the electricity, it acts like an attractive or repulsive force, which is exerted reciprocally by the zinc on the copper, and the copper on the zinc. In the first experiment, where the two pieces of copper are on the same side with the zinc, this force is allowed to exert itself, and the electricity which it disengages, spreads over the plate of copper of the condenser. But, in the second experiment, where the zinc is situated between the two plates of copper, the electromotive action, whatever be its nature, is exerted equally on the two sides of the zinc, and cannot, therefore, develope any electricity.

The metals, and a great number of non-metallic substances, act in this manner on their natural electricities when we bring them in contact with each other; and it is extremely probable, that this property extends in different degrees to every body in nature. Among all the combinations, then, that may arise from it, there will be some where the production of electricity will be more powerful, and others where it will be feebler and even insensible. In the first class are the heterogeneous metals, when they are brought in contact with each other; in the last are found pure water, saline solutions, and even liquid acids, brought in contact with each other, or with metals.

To verify this property, take a tube of glass open at its two extremities: shut one of them with a stopper of copper, terminated below by a stick of the same metal, which is prolonged within, as is represented in fig. 6, and fill this tube with any of the liquids above mentioned, with water, for example, with saline solutions, or even with an acid; we shall then have an arrangement exactly similar to that of the plates of zinc and of copper soldered end to end. But the electromotive property will be incomparably weaker. For, if we try it in the same manner, by touching with the finger the liquid in the tube, and carrying the stick of copper to the plate of the condenser, which is precisely the same mode as in the first experiment; then, how often soever we repeat this contact, the plate, thus touched, will never receive any sensible quantity of electricity. The same thing will happen, even if the liquid contained in the tube should act chemically on the stopper of copper; at least if we do not employ very great masses of liquid and of metal acting violently on each other; for, in that case, it is well known, that the chemical combination of two substances developes electricity; as Lavoisier and Laplace observed, in dissolving several pounds of iron filings in sulphuric acid. But, it is evident, that the electricity developed in this case is totally different from the phenomenon produced by the contact of metals or of heterogeneous substances in general; since, in the last case, the smallest quantities of these substances soldered together, and which, by their chemical action, do not produce on each other any sensible alteration, exert as much power as the largest masses; and, what finally indicates a very decided distinction between these two classes of phenomena,—if we try successively to estimate on the condenser the effects of the mutual contact of metals with metals, and of metals with the most powerful acids, using in both cases equal masses, and for the liquids the little apparatus above described, it will be found, that the electromotive force, exerted by the immediate contact of the metals, and the liquid conductors, is absolutely imperceptible.

But this property enables liquids to transmit the reciprocal action between the copper and zinc without weakening it by their contact. Thus, for example, if we take the second experiment (fig. 5), where the zinc was placed between two pieces of copper, we have seen, that, in that case, the electromotive forces, exerted upon the zinc, being equal and contrary, there was no developement of electricity, and the condenser was not charged. But, if between the zinc and the collecting plate, which is of copper, we interpose a stratum of conducting liquid, such, for instance, as a drop of water, or a piece of paper moistened with some saline solution, then the condenser will be charged. This intermediate body is now then sufficient to prevent the electromotive action of the plate upon the zinc, which only becomes manifest during contact; it cannot, at the same time, supply this action itself, as its own electromotive force is so very weak and insensible; and, lastly, in consequence of its conducting quality, it is enabled to transmit the electricity of the zinc, if the latter acquires any thing above its natural share. The zinc, therefore, is now in a condition peculiarly adapted for this developement, being interposed between two bodies which touch it, and of which the one, namely the copper, exerts on it a sensible electromotive action, while that of the other, namely, the liquid, is but extremely feeble. The production of electricity then will go on nearly as well as if the zinc were insulated in the air; and, from the communication which is formed by the humid conductor, it must, besides, necessarily happen that this conductor, and the plate of the condenser on which it lies, will divide between them the superabundant electricity of the zinc, until they acquire a repulsive force exactly equal to its own.

Hence, if we solder together two thin circular plates, the one of zinc and the other of copper, and if, after having laid this compound plate with the copper side on the hand, we cover the zinc side with a humid conductor, whose electromotive force is insensible, with a piece of cloth, for example, soaked in water, or some saline solution, all the conducting bodies which we place above this system will share in the excess of the vitreous electricity of the zinc side, and of the humid body which covers it. If then, on this first system, we place another similar one, so that its copper side may lie on the moistened cloth, this second system will then, as a conducting body, share the excess of the vitreous electricity of the first zinc side; and the second piece of zinc will, besides, take a new excess of electricity equally vitreous, produced by the electromotive force of the copper to which it is soldered. In thus adding successively several similar systems on each other, we obtain an apparatus in which the electric state of the successive pieces will go on augmenting from the bottom to the top, according to the number of pairs superimposed.

Such is the admirable instrument now universally known under the name of the *Voltaic Pile*, and by which both Natural Philosophy and Chemistry have obtained such astonishing results. To comprehend rightly its effects, we must analyse, with precision, the electrical state which the different pieces that compose it assume, as well as the changes that arise when we make any of them communicate with the ground or with a conductor.

To present this analysis in the simplest form, we shall first suppose that the humid bodies interposed between the pairs of metallic slates, serve absolutely no other purpose than to conduct from the one to the other the free electricity which is developed on the surface of the pieces, and that those liquids themselves do not in the least contribute to the production of the electricity with which the column is charged. This supposition, which we do not offer as at all definitive, but merely as the first case which we submit to examination, will have the advantage of showing distinctly, the phenomena which may be produced by the mutual contact alone of the metallic plates, and by the circulation of the electricity which results from it. We shall first then examine if this be sufficient to represent all the phenomena, and, secondly, what modifications must be applied to make it embrace them.

Let us consider, first, a single pair of metallic pieces formed of a plate of zinc soldered or firmly fixed to a plate of copper of equal dimensions; and place the copper side in communication with the ground. This side will then be in the natural state, but the zinc side will be covered with a stratum of free vitreous electricity, the total amount of which we shall represent by $+1$. The value of this unity depends on the extent of the two plates, and will be proportional to their surface.

The copper side communicating always with the ground, we place on the zinc side a piece of cloth soaked with saline water, or with any other liquid conductor whose electromotive action is insensible. Then the free electricity of the zinc side will spread itself over the surface of the conductor; but as the zinc must necessarily always possess the excess of vitreous electricity which its contact with the copper requires, it will draw a new supply from the copper, and the latter from the ground. All this is but a simple consequence of the experiment of Volta, related above.

Take now a new piece of copper and zinc, similar to the first, and after having touched its copper side and insulated it, place this side upon the moistened cloth, as is represented in fig. 7. According to Volta, two actions now begin; *first*, The zinc side of this second piece preserves the excess of vitreous electricity $+1$, which it acquires from its contact with the copper. *Second*, The whole system of the piece shares the free electricity of the cloth, as every other conducting body would do. The cloth renews this electricity, by drawing a supply from the inferior piece of zinc, this latter from the copper, and the copper from the ground; so that, after a certain time, which, if the conductibility be perfect, must be infinitely short, there arises a state of electrical equilibrium where the quantities of free electricity are such as is represented in the following table:

Superior piece,	Zinc side, Z_2 soldered to C_2,	$+2$
	Copper side, C_2, communicating with the moistened cloth, .	$+1$
Inferior piece,	Zinc side, Z_1 soldered to C_1,	$+1$
	Copper side, C_1, communicating with the ground,	0

On this system, lay a second cloth, then a third piece of copper and zinc in the same manner, fig. 8; the zinc side of this new piece will preserve its excess of vitreous electricity $+1$; but, besides this, it will share, like every conducting body, the free electricity of the inferior pieces, which will be supplied at the expence of the ground; and when the electrical state will have become permanent, we shall have

Piece 3.	Zinc side, Z_3 soldered to C_3,	$+3$
	Copper side, C_3 communicating with the moistened cloth c_2, .	$+2$
Piece 2.	Zinc side, Z_2 soldered to C_2,	$+2$
	Copper side, C_2, communicating with the moistened cloth c_1, .	$+1$
Piece 1.	Zinc side, Z_1, soldered to C_1,	$+1$
	Copper side, C_1, communicating with the ground,	$+0$

By continuing always the superposition of pairs in the same manner, the quantities of free vitreous electricity will increase from the bottom to the top, in an arithmetical progression.

This theory supposes that the transmission of the electricity through the moistened cloths is effected without any diminution. Such is the case with a perfect degree of conductibility. We admit, besides, that the liquids interposed between the metallic elements

exerts on them a force which either amounts to nothing or is so trifling as to be entirely overlooked. Finally, to pass from one element to another, we have joined to these data a third, namely, that the excess of electricity +1, which the zinc takes from the copper, is the same in these two metals, whether they are in the natural state or not. This last supposition is the simplest that we can make. It is not, however, a supposition of which the fundamental experiments above-mentioned afford any proof. We have heard it said by Coulomb, that he had verified this law, and that it had appeared to him exact. It is clear that it cannot well be established without the aid of the electric balance, and without measuring the quantities of free electricity at different heights in any pile; but such observations would be affected by the constant imperfection in the conductibility of the humid conductors, and by several other causes, which we shall examine afterwards. Be this, however, as it may, let us for the present admit the equal difference in question, and endeavour to trace the consequences by calculation, though this should only lead at first to an approximation.

First, then, if we touch with one hand the base of the pile, and carry the other hand to its summit, all the excesses of electricity + 1, + 2, + 3, of the different pieces, must discharge themselves through the organs into the ground. Supposing the transmission of electricity in the interior of the pile perfectly free, or only very rapid compared with its transmission through the organs, this discharge ought to produce a shock like that of the Leyden jar; but with this remarkable difference, that the sensation will appear to continue; for the pile recharging itself at the expence of the ground much quicker than the organs of living bodies can discharge it, the superior piece will be always almost as highly charged as before the contact. Experience entirely confirms these views; and we can also produce, in the same manner, but with infinitely greater intensity, all the phenomena of taste and of light which are excited by a single pair of pieces, and are described in the article Galvanism, in the *Encyclopædia*.

If it be required to discover in this case the quantity of electricity which forms the discharge at every contact, we have only to take the sum of the quantities of electricity, which, according to the preceding deductions, exist in a state of freedom in the different parts of the apparatus. But, to simplify this estimate, we may suppose the moistened cloths infinitely thin, and neglect the quantity of electricity which attaches itself to their exterior boundaries; then the preceding quantities, which are diffused over the surfaces of copper and of zinc, will be the only sums to be taken; and the amount will be found proportional to the square of the number of pairs, though it will presently be seen that this result is extremely enfeebled by the imperfect conductibility of the moistened bodies interposed between the pairs, and through which the transmission is effected.

We have supposed the pile fitted up in the order—copper, moisture, zinc, copper, &c.; the first piece of copper communicating with the ground. But we may also arrange it in a reverse order, namely, zinc, copper, moisture, zinc, &c. by forming the communication with the ground and the first piece of zinc. In this case, the theory will be quite the same, only that the unity +1 will become negative; or the quantities of free electricity will be of a resinous nature.

Instead of laying the metallic plates above each other, in a vertical column, we may place them horizontally and parallel to each other, on insulating supports; on sticks, for example, of varnished glass; then, instead of interposing between them pieces of cloth, which would with difficulty stand upright, we may form, from the one to the other, a series of a kind of troughs, of which they become the extreme boundaries; and into these troughs pour the liquids which are to serve as conductors. This is called the *Trough* apparatus, fig. 9, Plate LXXXI.* We may also solder together, and end to end, slips of copper and of zinc, bent at their point of junction, so that each metal may be plunged into a vase or cup of glass, or of porcelain, partly filled with a liquid conductor. A series of similar vessels forms an electromotive chain, of which the extremities may be brought circularly round towards each other, for the convenience of making experiments. Fig. 10. This is what Volta calls the apparatus *De tasses à Couronne.* But in whatever way this apparatus be arranged, the principle of its action is evidently the same; and the theory we have explained applies equally to all.

Let us now apply to the upper part of the pile, or in general to the last plate of the apparatus, a condenser, the inferior plate of which communicates with the ground. Previous to the contact, this plate, which we shall always suppose of zinc, possessed a degree of free vitreous electricity corresponding to its rank in the pile. The condenser carries off a part of this, which the zinc immediately supplies from the inferior piece, this from the following, and so on to the last, which draws the whole from the ground. This movement must continue until the superior piece has re-acquired the same quantity of free electricity which it possessed at first, and which corresponds to its situation. Thus the conductor will be charged, until the electricity spread over its collecting plate, has the same repulsive force as this plate of the pile with which it is in contact.

Were the pile fitted up in a contrary order, the zinc communicating with the ground, the free electricity at its summit would be resinous, and the charge of the condenser would be equal to the preceding, but also resinous: all these results are conformable to observation.

As the electricity of the column accumulates in the condenser, so it may spread itself in the interior of a Leyden jar, or of an electrical battery, the exterior part of which communicates with the ground; and, as the pile, in proportion as it discharges, recharges itself again, from the ground, the battery, put in communication with its insulated pole, will charge itself equally well, whatever be its capacity, until the repulsive force of its free electricity comes to balance that which exists at the pole with which

it is in contact. If we then withdraw the battery, it will give a shock corresponding to this repulsive force; and this also is confirmed by experiment.

In order that the action of the condenser on the apparatus, either of the pile or the troughs, may be regular, constant, and as powerful as possible, the greatest care must be taken to form, between its plates and the poles of the apparatus, the most perfect communications. For the quantities of free electricity being excessively minute, the least obstacle is sufficient to stop them, or, at least, considerably to retard their propagation; and in that case the condenser will take much less electricity than it would have done if the communications had been perfect. It is even much worse, if the mode of communication is itself variable; as when we hold the condenser in the hand, and merely place on the summit of the pile the extremity of a metallic wire fixed to its collecting plate. In this case, if we apply it several times in succession to the same pile, the quantities of electricity with which it is charged may vary in an instant from one to three, or even four times greater or less, in place of that perfect degree of equality which we would obtain with a more uniform mode of communication, and which is indeed absolutely necessary to discover the state of the pile, and to measure it with exactness.

The following is the arrangement of the apparatus, which, after many trials, we have found the most commodious. On a solid table, fix with screws a parallelopiped of wood AB, fig. 11, covered with tin foil. The extremity A of this parallelopiped carries a cone of metal, truncated, well polished, and on which the pile is laid. The other extremity B carries an upright and moveable stick of metal TT, terminated by a metal plate, to which the foot of the condenser is firmly fixed by a metal screw. This instrument may then be adjusted to the height of the pile, with which the experiments are made without altering the proper condition of the communications. The plates made use of are all of the same dimensions, and each plate of zinc is strongly attached, but not soldered, to the corresponding plate of copper, so that the contact is in this manner always completely established between them. We have only, then, to dispose the pairs above each other; and when the plates are new, those pairs may be reckoned identically the same. As they are also perfectly plane, the pile may be easily enough erected by placing them above each other, without any lateral supports, and by this method we also avoid that kind of communication between the poles of the pile, which arises, to the great injury of the apparatus, from the imperfect insulation of these supports.

Lastly, to establish constantly, and in the same uniform manner, the contact of the condenser with the top of the pile, place on this a little cup of iron, filled with mercury, and whose inferior surface is perfectly flat; and let us suppose, that the extremity of the flexible stick of the condenser is made with iron, as the little cup itself; then, when the instrument is adjusted to the height of the pile, we have only to immerse the end of this stick into the mercury, by means of a tube of varnished glass, and abandoning the stick to its own elasticity, we are certain of obtaining a contact as equal and instantaneous as possible; which may also be still farther prolonged, to observe, if desired, the influence of time on the charge of the condenser. When the stick is taken out of the mercury, we raise the collecting plate quite parallel to itself, and touch it with the fixed insulated ball of the electrical balance. (See ELECTRICITY, *Supplement.*) We replace this in its glass case, and the moveable disk of the balance, which may be supposed in its natural state, touching it, is immediately repelled to a certain distance, which we can observe; or still better, we may turn the thread of suspension, until the disk is brought to a fixed distance from the sphere. Whichever way we adopt, as the disk will become electrified by the contact at the expence of the ball, the angle of torsion will measure the square of the quantity of electricity communicated to the ball by the condenser, and to this last by the pile, and we shall then be enabled to estimate this quantity very exactly. In using this method, we always obtain, by a series of consecutive experiments, results that agree perfectly with each other; which is far from taking place, when we neglect the precautions to ensure the perfection and the identity of the contact of the condenser: it is evident, besides, that the same disposition of the condenser is equally applicable to the apparatus of troughs.

By comparing, in this manner, the charges obtained from piles of the same number of plates, constructed with moistened conductors of different kinds, we find, that water, weak acids, the greater number of saline solutions, the substances in general whose conductibility is powerful, give, as nearly as can be judged, the same quantities of free electricity, and give it also by a contact to our senses instantaneous. We may even, with most of these conductors, increase or diminish extremely the extent of their surfaces, without producing any sensible variation in the charge of the condenser, owing, no doubt, to the facility, almost infinite, which their surfaces present to the transmission of the electrical currents. But this is sufficient to prove, in every case, agreeably to the opinion of Volta, that they only act the part of conductors, and that their contact, or their chemical action, is not the determining cause of the production of the electricity. With some liquids, however, we find the charges unequal with the same number of plates, whether that they weaken too much the conductibility by their interposition, as will be presently explained; or that they exert an electromotive action peculiar to themselves, or to the combinations which they form with the other parts of the apparatus; all these varieties presented themselves in the numerous experiments made by philosophers during the first period of the invention of the electromotive apparatus.

In the preceding discussion, we have always supposed, that the electromotive apparatus communicates by its base with the ground, from which it may draw all the supplies of free electricity necessary for the equilibrium of its parts. But, if we conceive all the pieces which compose it to be placed originally on an insulator, and that the column itself, and the observer who arranges it, were insulated during the time of putting them together, then the quantities of free electricity, necessary for the equili-

brium, could not be derived from the ground, and the pile would now supply them of itself by the decomposition of the natural electricities of its plates. The zinc pole would acquire an excess of free vitreous electricity, balanced by an equal excess of resinous electricity at the pole of copper; and from these extremes the quantities of free electricity would go on diminishing to the middle of the column, which would be in a state of neutrality. It is obvious, in fact, that in this manner the conditions which produce the equal differences of one piece from another would still be observed; and the pieces would preserve, in respect to their quantities of electricity, the same rank we have assigned them in the uninsulated apparatus. These considerations are confirmed by experiment, at least in their general results; for all piles, even those which have been at first erected in communication with the ground, pass into the state we have here described, when they are placed on an insulator of very small dimensions. The air, in fact, which touches them, gradually carrying off, in this case, their free electricity, they cannot be recharged, but at their own expence; and the result of this decomposition of their natural electricities is the only portion which remains, after their supply of electricity drawn from the ground is at length spent by the effect of the air. In this state, the indications of the electrometer at the two piles are very weak, and even the most powerful condensers are not sensibly charged. Such an effect is the more worthy of remark, as it does not accord with the theory of the equilibrium by equal differences. This theory shows, indeed, that the charge of the condenser in the insulated pile must be less than in that which is not insulated; but the proportion which it would point out is very far from approaching that extreme degree of weakness, which experience indicates.

By reflecting on this discordance, we are led to think that the electrical action of the electromotive apparatus may probably be owing, not merely to the quantities of free electricity which appear on its elements, as Volta supposed, but that there may exist in it at the same time a very great quantity of latent electricity; and as this consideration would greatly alter the light in which the action of the pile ought to be viewed, we shall here explain it more particularly.

Let us first recollect the fundamental experiments of Volta on the production of electricity, by the simple contact of two insulated metals. What do these show?—That there is then manifested upon each of them a certain quantity of free electricity, and that it consists of two opposite kinds. But does it follow from this, that these small quantities are the only ones which are really developed? Undoubtedly not; and the decomposition of the natural electricities of the two plates during the contact might be enormous, without producing any other external indications than those that have been observed. Hence, we see very often that the two sides of a thin plate of glass, coated with metal, may be charged with a very considerable quantity of electricity, although the portions set at liberty, and exerting their repulsive force on the electrometer, are very trifling.

In this view, two plates of zinc and of copper, brought into contact, would exactly resemble a similar plate of glass, after we have insulated it, and after the absorbing action of the air has equalized the repulsive powers of its two sides. Only, in place of the insulating stratum of glass which prevents the two electricities from reuniting, there will be in the metals the electromotive forces, which will retain the two electricities on each side of the surface of contact; the electrometer and the balance will then render sensible only those portions of electricity which are set at liberty from the two sides of this surface; and the total quantities of disguised electricities will only become manifest at the moment we form a direct communication between the plates, in the same manner as in the Leyden jar, or electrified plate of glass.

The electrical state of the electromotive apparatus will thus be exactly similar to a heated tourmalin; or, to take a more obvious example, it will be similar to that of an electrical pile formed by a mass of several plates of glass, coated with metal, and of which the opposite faces, parallel to each other, communicate by metallic conductors. Fig. 12. An apparatus, indeed, constructed in this manner, being charged with ordinary electricity, presents, both in theory and in fact, an exact representation of the electrical phenomena which the electromotive apparatus produces, whether one of its poles communicates with the ground, or is in a state of insulation; and if it does not exert the same power of decomposition on chemical combinations, it is very probable that this arises from the impossibility of recharging its electrical poles instantaneously and continually, in proportion as they discharge themselves along the substances through which the electrical currents pass; a faculty which the electromotive apparatus possesses of itself, when the humid conductors, which separate its metallic elements, present a sufficiently open passage for the transmission of the electricity. This view of the electromotive apparatus will enable us to conceive how it can excite such violent commotions, and, above all, those chemical phenomena which we can only produce, by accumulating considerable quantities of electricity, either with batteries, or by means of extremely fine points, as has been done by Dr Wollaston. This great energy will not be at all surprising, since a very great quantity of electricity would thus appear to be also operating in the chemical action of the electromotive apparatus. Lastly, it will be understood, why piles, even the most powerful, when they are insulated at their base, scarcely communicate any sensible electricity to the condenser, while they give charges of considerable power, and which even emit sparks, if we make one of their poles communicate instantaneously with the ground. For the charges of the condenser, as they are indicated by calculation for these two circumstances, would bear to each other an extreme disproportion, which is not the case according to the first view of the subject.

Having thus examined the electrical phenomena, which the Voltaic apparatus produces in consequence of the electromotive action alone of the metals which

compose it, let us now inquire into the modifications that the more or less perfect conductibility of the humid bodies which separate them must occasion in these effects.

In the first place, if these bodies, in their contact with the metals, exert a sensible electromotive action, they will modify the electric state of every pair of metal plates, as well by the very existence of the new portion of electricity which they develope, as by the changes which hence result in the conditions of the electrical equilibrium of each pair; but whenever the electromotive action of these bodies shall become known or determined, their influence will then only form an additional element to join to the considerations which we have already employed; and the new state of electrical equilibrium which must now be established in the column will be determined precisely in the same manner, and by the application of the same process of reasoning.

But, besides the conditional modifications which may thus be determined by the nature of the conducting liquids themselves, there are others in some measure inevitable, and which arise from the changes that the various constitution, or the progressive alteration of the humid conductors introduce, either in their electromotive faculty, or in the rapidity of the transmission of the electricity. As the current of electricity, excited by the Voltaic apparatus, acts on the bodies through which it passes, and often attacks and decomposes them (as is shown in the article GALVANISM); it must also, by the same power, act upon all the decomposible bodies which enter into the construction of its own system; so that it becomes indispensable to examine, by experiment, the nature, the extent, and the consequences of this action.

Among the phenomena which it produces, the first to be examined, because it is the most general, is a rapid absorption of the oxygen of the air around the apparatus. This may be rendered apparent in a very simple manner, by placing a vertical pile upon a support surrounded with water, and covering it with a cylindrical jar of glass, which also dips into the water at its base. See fig. 13. In a few instants, the water will be seen to rise in the interior of the jar, especially if we form the communication between the two poles of the pile by metal wires, so as to direct through them the circulation of the electricity: when no communication is formed, the absorption still goes on, but with much greater slowness. In every case, in more or less time, according to the volume of the pile, and the quantity of air which surrounds it, the absorption ceases, and the air remaining under the jar presents no more traces of oxygen. This phenomenon was discovered by MM. Biot and Frederic Cuvier, when the electromotive apparatus became first known in France.

But, by a fine observation of Dr Wollaston, we are now enabled to proceed farther, and to penetrate into its cause. It consists, without doubt, in the affinity of oxygen, for the surfaces electrified vitreously, as the zinc elements of the pile are; and it is, in fact, these elements which are found to be oxydized. The effect is peculiarly strong and lasting when the pile is placed under a jar filled with pure oxygen. In that case, the effect on the organs, if tried, is found to be prolonged far beyond the time it would have lasted in common air; and, in this last case, when the pile, having absorbed all the oxygen, is surrounded by an atmosphere of azote, and its energy now appears completely extinguished, the letting in of a small quantity of oxygen is sufficient to revive it.

When we separate the elements of the piles which have been thus kept in action during several hours, or even days, under a cover which prevents the renewal of the atmospheric air, and having a constant communication kept up between their poles, we find that the metallic plates which compose them adhere to each other, and to the intermediate moistened cloths, with so great a force, that it is difficult to separate them. When this is done, we observe that the chemical action of the pile appears to have reacted on it, and produced remarkable alterations on its own elements. If the pile has been raised, according to the order, zinc, moisture, copper, zinc, &c. fig. 14, and placed on its zinc base, we observe invariably that particles detached from the inferior zinc plate have been carried to, and have fixed themselves on the plate of copper above it, while particles of copper have been transported to the superior zinc, and so on from the bottom to the top of the column. If the situation of the pile is the reverse, namely, copper, moisture, zinc, copper, &c. fig. 15, the copper descends upon the zinc, which is below it, and the zinc on the copper, from the bottom to the top of the column. The direction of the *transport* along the pile is reversed, but it remains the same relatively to the order of the elements of which the apparatus is composed.

According to this arrangement, the zinc, in order to reach the copper, must necessarily pass through the small piece of moistened cloth which separates them. In piles where the communication between the two poles is not formed, this transmission does not sensibly take place; the surface of the copper remains smooth, and that of the zinc, which is opposite to it, is only covered with minute black lines, which follow the direction of the threads of the cloth. When the communication has been established for a short time, some particles of oxide begin to pass, and attach themselves to the copper; and, if the action of the pile is strong, the surface of the copper is at last entirely covered; then the chemical and physiological action of the pile ceases, either because the oxide of zinc deposited on the copper exerts on it an electromotive action, which balances that of the metallic zinc, touching it on its other side; or because the interposition of this stratum of oxide presents too great an obstacle to the transmission of the electricity; or lastly, what is most probable, because these two effects combine their influence at the same time.

Sometimes the oxide of zinc, after having passed through the piece of cloth, restores itself on the copper to the metallic state. Then the element on which this precipitation falls loses all its electromotive force, the copper being then in contact between two pieces of zinc.

The motion of transport being directed from the zinc to the copper, through the moistened conductors; when the copper attaches itself to the zinc, this always takes place on the sides of their immediate contact with each other. If the copper then adheres to the zinc, it preserves its metallic polish. Sometimes brass is formed. These revivals of the metal do not take place when the communication is not established between the extremities of the pile: it is also necessary for their production, that the cloths be not too thick, nor of too compact a texture.

Such, we believe, are the first of the phenomena of transport which have been observed with the electromotive apparatus, and which have been described by Messrs Biot and F. Cuvier; they are particularly sensible in piles composed of plates of a very small diameter; the reaction of these piles upon themselves is incomparably stronger and quicker than that of piles of large plates.

All these changes within the pile being well established, we must inquire what influence they can have on the electrical state, and consequently on the chemical permanence of the electromotive apparatus.

Let us begin with the absorption of oxygen, by which the chemical agency of the pile is augmented. It is clear, that this increase would not take place if the conductibility of the pile were perfect; for each of its elements would, in that case, instantly draw from the ground, by direct transmission, the quantity of electricity necessary for the rank which it occupies. But the preceding experiments show that such an effect is quite ideal; and however useful this view of the case may at first be, to illustrate more clearly the increase of electricity which arises from the superposition of pairs of metallic plates, we must modify these abstractions by introducing the circumstance of an imperfect conductibility, in order to have a complete idea of the pile as it is really in our power to construct it.

According to the notions of Volta, the oxygen can only operate by forming a more intimate communication between the metallic elements of the pile; binding them, as it were, by oxidation to each other, and to the imperfectly conducting cloths which separate them; and no doubt this adherence may contribute to augment the conductibility, especially in the beginning of the action. But when this action becomes so strong that the whole pile only forms, as it were, a solid mass; when the moistened cloths interposed between the plates are dried; when all the oxygen which surrounds the pile is absorbed, and its chemical agency seems altogether extinct,—what new degree of adherence can the introduction of a new quantity of oxygen instantaneously produce? Does it not rather seem that this oxygen revives the pile, by insinuating itself between the pieces of cloth, and carrying to each plate of zinc with which it combines, the quantity of electricity that this plate requires for its recharge, according to the rank which it occupies? The electrical state of the plates becomes then the same as if they had drawn their electricity from the ground; they recover their losses with the same rapidity; and the chemical action of the pile begins again to exert itself as before the drying of the humid conductors.

But if it be the oxygen which furnishes the electricity to the zinc, whence does it derive this electricity itself? Is the latter disengaged in its combination with the zinc, and do the chemical phenomena in general which take place within the pile produce the electricity for which they have occasion? Delicate experiments made on this subject with the electrical balance prove, that the proportion of electricity which can arise in this manner, is incomparably smaller than that which really circulates in the apparatus; the oxygen, therefore, which surrounds it cannot prolong the action of a pile, but by serving itself as a conductor between the metallic elements which compose it; and the following is the mode in which we may conceive this communication to take place.

Conceive a pile raised in the order—copper, zinc, moisture, and make it communicate with the ground by its copper base. In the state of equilibrium all the pieces of this pile will have an excess of vitreous electricity depending upon the rank which they occupy. If we touch the upper piece, the excess which it possesses will run out into the ground, and it will tend to re-supply itself from the inferior pieces across the humid conductors. But these conductors not being perfect, a certain time is necessary for this effect; and if we repeat the discharge before the restoration has been completely made, the upper piece will take vitreous electricity from the piece of copper which it immediately touches, so that the latter will acquire an excess of resinous electricity; and the same thing will happen, more or less, to all the metallic pairs which compose the pile.

This being established, introduce now round the plates an atmosphere of oxygen. According to Dr Wollaston's experiments, this oxygen will be attracted by all the pieces of zinc that are in the vitreous state; it will combine then with their substance in consequence of its affinity for them, and of the electrical influence which produces it. But the oxide of zinc which results will, in its turn, be attracted towards the surface of the upper piece of copper, which the imperfection of the conductors leaves in a resinous state; it will carry then to this piece the vitreous electricity of the metallic zinc which it abandons; and this motion of transport continued from the bottom to the top of the pile, will re-establish the transmission of electricity. The same thing would still happen in a pile communicating with the ground by its summit of zinc, because the imperfect state of the conductors will allow, in the same manner, the metallic elements to acquire opposite states of electricity.

This explanation, which we owe to Sir H. Davy, applies equally well to all the other chemical decompositions which go on within the pile. The products which result, attracted towards the differently electrified surfaces, transport along with them the electricity of these surfaces, and produce directly the same result which would arise from a perfect conductibility.

All the modifications then which occur in the chemical condition of the humid conductors, must be expected to influence the action of the pile, and even the quantity of electricity which it communicates to the condenser by a simple contact; hence the dif-

ferences which the same piles present at different periods of their action; and this ought also to have an influence on their change of power according to the number of pairs of plates employed.

The progressive and inevitable decline in the power of electromotive machines constructed with humid conductors, has given rise, among philosophers, to a vast number of attempts to discover some construction of a pile with all its conductors perfectly dry. Hitherto their efforts have been vain, or at least the piles thus formed have never possessed a conductibility sufficient for the production of chemical decompositions, the principal object for which a permanent apparatus is to be desired.

In this respect, Volta discovered among metallic substances a very remarkable relation, which renders the construction of a pile with these substances alone, impossible. This we shall now explain according to the views of Volta, but without having had any opportunity of verifying it ourselves.

If the metals be arranged in the following order,—silver, copper, iron, tin, lead, zinc, each of them will become vitreous by its contact with that which precedes it, and resinous by its contact with that which follows it. The vitreous electricity will then pass from the silver to the copper, from the copper to the iron, from the iron to the tin, and so on.

Now, the abovementioned property consists in this, that the electromotive force of the silver upon the zinc is equal to the sum of the electromotive forces of the metals which are situated between them in the series; so that, in bringing them into contact in this order, or in any other whatever, the extreme metals will always be in the same state as if they had touched each other directly. Hence, if we suppose any number of elements thus arranged, the extremities of which, for example, may be silver and zinc, the same result will be obtained, as if the elements had only been formed of these two metals; that is, the effect, if any, will be the same as what would be produced by a single element.

The preceding property, so far as we yet know, extends to all solid bodies, which are very good conductors, but does not subsist between them and liquids; and it is for this reason that we are enabled to construct the pile by the interposition of the latter. Hence arises the division which Volta made of conductors, into two classes, the first comprising solid bodies, the second liquids, and we cannot yet construct the apparatus of the column, without a due combination of both. With the first alone it is impossible, and with the second, we are not yet sufficiently acquainted with the mutual actions of the bodies that compose it, to decide whether it is possible or not. This does not appear, however, to be the case, for nature itself really presents us with liquid piles in the electrical apparatus of certain species of fishes, particularly the torpedo. This apparatus, situated near the stomach of the animal, is composed of a multitude of tubes, ranged side by side, and filled with a particular liquid. It appears that the animal can put this pile into action at will, and it can then communicate real electric shocks to the living bodies which it touches.

If we have not been able, however, to form a Voltaic apparatus absolutely dry, and possessing a strong power of decomposition, we may, at least, obtain one whose action, though in truth very weak, is of very long duration; such is the pile which Mr Hachette has constructed with pairs of metallic plates, separated by a simple layer of farinaceous paste, mixed with marine salt. When this layer is dried, the moisture which it attracts from the atmosphere renders it sufficiently conducting, to admit the re-establishment of the electrical equilibrium among the metallic elements, in a period of time quite imperceptible. It then charges the condenser by a simple contact, to our senses instantaneous; and it preserves this property for whole months and years, which renders it a real electrophorus; but it excites neither shock nor taste, nor chemical action. Mr Zamboni has also constructed a pile, the electrical effect of which appears to be very durable. He composes it with discs of paper, gilt or silvered on one of their sides, and covered on the other with a layer of pulverized oxide of manganese. In the superposition of these discs, then, the pairs of metal plates are formed of silver or gold in contact with oxide of manganese, and the interposed paper serves as the conductor. Hence arises a very weak transmission of electricity. With this system we obtain signs of the electrical influence in the same manner as with the pile of paste; but neither chemical action nor shock, nor even taste. This last class of phenomena, then, requires a more rapid re-establishment of the electrical equilibrium; and to demonstrate the extreme effects of its retardation, Mr Biot constructed piles in which discs of nitrate of potash, melted by heat, were substituted for the moistened body; then the conductibility was so weak, that the condenser took a sensible time to charge itself, and continued charging more and more until a certain limit, which was the same as with the most powerful piles having the same number of pairs of plates. From the observed law of these charges, we may conclude, that the initial quantity of electricity communicated by such a pile to the condenser, in an infinitely small portion of time, is incomparably less than with the ordinary piles; and, as it is these initial charges which produce chemical decompositions when the communication is formed between the two poles, we may understand why these piles, where the conductibility is very weak, do not produce these phenomena, and excite neither chemical action, nor taste, nor shocks. This consideration of the initial velocities affords a very simple explanation of a great number of phenomena, apparently very puzzling. They show, for example, why the apparatus with cups, filled with a weak acid, exerts, at the moment it begins its action, a very intense power of decomposition, which is quickly weakened; and, after an inconsiderable interval of time, seems almost extinct, though the condenser applied to its columns is always charged by a single contact, with the same quantity of electricity. This is owing to the contact, although very short, not being altogether instantaneous. It may seem so to us, although the rapidity of the charge, during the instant it lasts, may have suffered enormous variations. The final equality of this charge, then, affords no information as to the progressive law by

which it has been formed; and does not prove that this law is similar or different. But the more or less intense power of decomposition produced by the electrical current is a much clearer proof of its rapidity; because these decompositions depend at once on the absolute quantities of electricity transmitted, and of the rapidity with which it is successively furnished by the apparatus, in proportion as the circle of conductors through which it passes discharges it continually.

This unequal velocity of the electric current, in different Voltaic piles, or in the same apparatus at different periods, may be rendered in a manner palpable by the following experiment: Having formed a pile where the conductors are layers of farinaceous paste, insulate it on a cake of resin, and make its two poles communicate by means of a prism of alkaline soap, in the middle of which the two conducting wires attached to these poles are sunk, in such a manner that their points of insertion may be always asunder. The soap will now be seen to conduct the electricity sufficiently well to discharge completely the poles of the pile, in proportion as they are recharged by the decomposition of the natural electricities of the discs; for all electrical tension will completely disappear from these poles; and, if a condenser be applied to them, it will not charge itself in any degree, whether the pile be insulated, or the communication be even formed, through the medium of the most perfect conductors, between the soap or the discs and the ground. But, if the same piece of soap be interposed between the two poles of a pile of equal tension, constructed with a good liquid conductor, such, for example, as a solution of muriate of soda, it will not be capable of completely discharging it as fast as it is recharged. There will remain always a degree of electrical tension at each of its poles, which may be capable of charging the condenser. Although these two piles, therefore, may both attain the same degree of final charge, and the same degree of repulsive force at their poles, the total quantity of electricity which they put into circulation in a given time may yet be different, may even be incomparably greater in the one than in the other, and may thus render the one capable of producing chemical decompositions, which it is absolutely beyond the power of the other to effect.

Confined by the object of this article to what concerns the electromotive apparatus itself, it does not belong to us to explain, in detail, the brilliant discoveries to which it has given rise, when employed as the agent of chemical decomposition by Messrs Hisinger and Berzelius, and, above all, by Sir Humphrey Davy. We cannot, however, resist giving here, at least, an idea of these important results.

We have already seen, in the article GALVANISM, the singular power which the Voltaic apparatus possesses of separating the constituent principles of water. This experiment, a thousand times repeated, has been elaborately studied in its details, and has led to conclusions very useful in respect to other chemical decompositions. We shall, for this reason, therefore, first of all describe this process. The most convenient apparatus for doing it well, seems to be that which has been contrived by Messrs Gay-Lussac and Thenard. It is represented at fig. 16, Plate LXXX.* E E is a glass funnel, the mouth of which B is closed by a stopper coated with sealing-wax, across which two wires of platina are made to pass parallel, and distant from each other nearly half an inch; these wires rise within the funnel an inch and a half, or two inches, above the bottom of it. Water is then poured into the funnel, and each wire is covered by a small glass tube sealed in the top, and also filled with water. The external extremities of the wires are then made to communicate each of them with a pole of the pile, and the apparatus is arranged. After it has acted for some time, the communication between the two poles is interrupted, and measuring the volume of the gas disengaged under each covered glass, we there find twice as great a volume of hydrogen as of oxygen. These are, in fact, the proportions which constitute water; for, on re-establishing the combination, there remains no gaseous residuum; at least, when the water exposed to the electrical current has been previously deprived of its air, and is preserved from the contact of this fluid during the operation, which may be done, either by covering the funnel with a cover properly luted, or in placing it in a vacuum. Without this precaution the gases disengaged by the pile would mix with portions of atmospheric air, either previously contained in the water, or absorbed by it during the operation; so that the nature and the proportion of the product would be altered by these circumstances. But, besides this, in order to lose nothing of the action of the pile, the communication of the decomposing wires with the extreme elements must be perfectly established; and nothing is more convenient for this purpose, than plunging them into a little cup of glass filled with mercury; in which are plunged two thick wires of iron, cemented to the extreme plates of the electromotive apparatus.

With this arrangement Messrs Gay-Lussac and Thenard have observed, that the quantity of gas disengaged in a given time by the same pile, whether constructed with moistened cloths or with troughs, varies considerably according to the nature of the substances dissolved in the water with which the funnel is filled. Concentrated saline solutions, and compounds of water and acids, give the most abundant and most rapid disengagement. This phenomenon diminishes as the proportions of salt or of acid become smaller; and lastly, when the funnel contains only boiled and perfectly pure water, almost no more gas is disengaged. Thus pure water, which transmits powerfully the electricity which is excited by our ordinary machines, becomes almost an insulating substance in the case of the weak repulsive forces to which the electromotive apparatus gives rise. This result is conformable to the general laws which have been observed in regard to imperfectly conducting substances. For, with all supports of this kind, the state of perfect insulation takes place at a certain degree of repulsive force, which is reciprocally as the square roots of their lengths. For a given distance of wires then, the insulation of the two poles of the pile can only be perfect with a certain degree of repulsive force, determined by the number of plates of the appara-

tus; and for each electromotive apparatus, there must be a certain distance between the wires, at which the communication may be entirely interrupted. We may also perceive, in these experiments, the influence which the more or less extended contact of the support with the insulated body exerts, in general, upon the state of insulation. For Messrs Gay-Lussac and Thenard have remarked, that, in shortening the wires beyond a certain point, the quantities of gas disengaged in the same liquid have considerably diminished, but have again augmented by substituting in the funnel a more conducting liquid. This imperfect conductibility of water may be rendered sensible by a very simple experiment. Having insulated a pile, and placed conducting wires at its two poles, plunge these wires into a cup of glass partly filled with common water, immediately the gas will rise in abundance. If one of the wires be drawn out of the water, and holding it in one hand, the other be plunged in the water of the cup, the ordinary shock will be felt. But, instead of this, form the communication by a column of water, of one or two-tenths of an inch in diameter, and an inch or an inch and a half in length, which may be done by drawing up the water of the cup into a tube of these dimensions, held in the mouth. In that case, although the most sensible organs now form part of the arc of communication, a very slight taste may be felt, but not the least shock. We have arranged, in this manner, a pile of 68 pairs, and of which the poles communicated with tubes, not capillary, filled with distilled water, and about 39 inches in length. The apparatus remained thus fitted up, during 24 hours, without an atom of gas being disengaged; and in attempting to communicate from the one pole of the pile to the other, by means of the columns of water contained in the tubes, none of the sensations which the electromotive apparatus usually produces were any more felt. In a word, every thing happened as if an insulating body had been interposed between the two poles. But all the effects reappeared whenever an immediate communication was made along the free surface of the water. For this reason, it could have been wished, that, in the experiments of Messrs Gay-Lussac and Thenard, the attempt had been made to extend the wires along the surface of the water itself; for we are of opinion, that, in this case, the communication between the two poles of the pile would have been established.

Messrs Gay-Lussac and Thenard have tried if they could discover any relation between the quantities of gas disengaged by a pile, and the quantities of salt dissolved in the water of the funnel; but they have not found any simple relation except for the sulphate of soda. The quantities of gas disengaged in a given time are very nearly proportional to the cube roots of the quantities of this salt contained in the water, whose decomposition is going on. The solution of nitre presents an opposite effect. Saturated with salt it produces less gas than when not saturated. On this subject, we ought to consider two things,—the decomposition which the water suffers, and that which the salt also suffers in its elements. The phenomenon being compound, it is clear that the result must also be compound.

Galvanism.

Much research has been spent in order to discover how the decomposition of the water, in the circumstances that we have described, is effected; for it cannot be doubted that the water is decomposed, since the proportions of gas disengaged are always in the ratio of its constituent principles. In the absence of any thing decisive, an opinion has been proposed which seems extremely plausible, namely, that the particles of water situated between the two wires, being influenced by the opposite electricities which emanate from them, arrange themselves, one after the other, like a row of condensers, or of electrical plates, in each of which there is a vitreous and a resinous pole; so that each resinous pole of one particle touches a vitreous pole of the other; and at the extremities of the chain, the metallic wire, which possesses the vitreous electricity, communicates with a resinous pole of one of the particles, and reciprocally. Suppose that, in this polarization, the oxygen of the water possesses the resinous electricity, and the hydrogen the vitreous electricity; then, if the energy of the pile is so powerful as to decompose the first particle of water, this will suffice for the whole chain. The oxygen of this particle being set at liberty, will rise under the form of gas, or will combine with the vitreous wire, and oxidate it. The hydrogen of the same particle will then be also set at liberty; but as it possesses the vitreous electricity, it will be attracted and retained by the oxygen of the following particle, which possesses the resinous electricity. It will thus decide in its turn the decomposition of this particle; will combine with its oxygen, and will form a new molecule of water. This combination will set at liberty the hydrogen of the second particle, which will act in the same manner on the following, until at last the decomposition will be transmitted to the particle of water which is in immediate contact with the resinous wire. The electrical action of the molecules upon each other will be prolonged no farther; and the hydrogen of the last particle, not finding any more electrified oxygen with which it can combine, will consequently disengage itself on this wire or combine with it.

What we have said concerning water will apply to every other compound which the electromotive apparatus decomposes. The possibility of this phenomenon will then depend in general on three elements; 1*st*, On the greater or less disposition of the constituent principles to assume in each particle of the compound the opposite states of electricity. 2*dly*, On the greater or less energy of this opposition. 3*dly*, On the relation between this energy and the chemical affinity which the principles of the compound exert on each other. If we operate, for example, on a body, of which the principles take with facility a very opposite state of electricity, it may happen that the pile will decompose this body, although the chemical affinity which unites its principles be very powerful. If, on the contrary, the affinity is very weak, but the constituent principles of the substance have, at the same

 time, very little tendency to run into the contrary states of electricity, it is very possible that the decomposition will not be effected. Lastly, as in the friction of bodies against each other, we see very often the same substance take successively the state of vitreous and resinous electricity, according to the different nature of the rubber to which it is applied; in like manner it may happen, that the same chemical principle may take successively the one state or the other, according to the combinations into which it enters; and although, in general, every principle must carry into all its combinations the same natural dispositions, yet the final result may depend also on the dispositions, similar or different, of the principles with which it may be united. In all the experiments which have hitherto been made with the electromotive apparatus, the oxygen has appeared to have preserved this disposition to the resinous state, which has been recognized in it in the case of water, and which is also remarked in experiments made with ordinary electricity, where the oxygen of the air always attaches itself to surfaces electrified vitreously. It even happens when bodies are found to be composed of several principles, some of which have strong affinities for oxygen, that the latter communicates to them the resinous disposition, and draws them towards the vitreous pole; while the other principles, on the contrary, then take the vitreous state, and are carried towards the resinous pole. By this law, all the oxides, and the acids which contain oxygen, have been decomposed by the electromotive apparatus, and the principle which was united to the oxygen has been transported to the resinous pole; while the oxygen, according to its constant disposition, has moved to the vitreous one. These fine observations were first made by Messrs Hisinger and Berzelius. Sir Humphrey Davy, in varying and extending them, was led to try the action of the electromotive apparatus on the alkalies, which had hitherto been regarded as simple bodies; and it was then that he observed bubbles of oxygen rising at the vitreous pole, while there were collected at the resinous pole shining substances of a metallic aspect and yet extremely light; burning in the air with violence, and even possessing the singular property of taking fire under water. Such were the metallic bases of soda and of potash, which have since been called *Sodium* and *Potassium*. But these properties did not permit the new substances to be obtained, except in very small portions, which were no sooner formed than they were dissipated in the air. It was necessary, therefore, to obtain, if possible, some method of preserving them from the destroying contact of the air, and Dr Sebeck conceived for this purpose a very simple process, which consists in combining *sodium* or *potassium*, as they are disengaged, with mercury. In a small piece of soda or potash we form a hollow to contain the mercury; we place this on a metallic plate, and immerse in the mercury the resinous wire of the electromotive apparatus, which must contain at least 200 pairs of plates. We make the other wire communicate with the metal support, and then the soda or the potash is decomposed, as well as the water which it contains. The oxygen of each of them moves towards the vitreous pole, to which its electrical state attracts it; the hydrogen and the sodium or potassium which quits it, proceed, on the other hand, to the resinous pole; the hydrogen there rises under the form of gas, and the potassium or the sodium combine with the mercury, which thus preserves them from the action of the air. The amalgam is poured from time to time into oil of naphtha, and the mercury is renewed. When a certain quantity of amalgam is collected, it is distilled in a retort with the smallest quantity of air possible. The oil first evaporates, then the mercury, and the sodium or potassium remain at last pure. In order that the decomposition of the potash or the soda may be effected by the process which we have described, these alkalies must contain a sufficient quantity of water to transmit the electricity of the pile; not, however, so much as to require, for the decomposition of this water, the whole effect of the electricity transmitted, for then the potash and the soda would not be decomposed. By a process of this kind, Sir Humphrey Davy and Dr Sebeck have succeeded in obtaining in the other alkalies undoubted signs of decomposition. But any more details on the subject would be foreign to the present article. We shall only add, that, setting out from the first discovery of Sir Humphrey Davy, on the composition of potash and soda, Messrs Gay-Lussac and Thenard have succeeded in depriving these substances of their oxygen, by the action of chemical affinities alone.

We have hitherto only considered the agency of the pile in the decomposition of bodies. It produces, however, most remarkable effects of a different kind. If we form the communication, for example, between the two poles, by very fine metallic wires, and make them gently approach until they touch each other, an attraction arises between them which keeps them united in spite of the force of their elasticity. If these wires are of iron, a visible spark is excited between them, which, as we shall see immediately, produces a real combustion of the iron. This experiment succeeds with greater certainty when the extremity of one of the iron wires is coated with a thin gold leaf, the latter being consumed at the place where the spark issues. With this spark we may inflame any explosive gas, and even phosphorus and sulphur, in the same manner as with the sparks from electrical machines.

We are here merely alluding to the effects produced by the most common piles, the plates of which are nearly of the size of a crown piece. But it is easy to conceive that they must become much more considerable if we employ plates of a greater extent of surface, and collected in the same number. For in piles where the number of the elements and the nature of the humid conductors are the same, the thickness of the free electrical stratum upon each plate of the same rank is also the same, as is indicated by theory, and also, as we have already seen, by experiment. Hence it follows, that the

total quantities of electricity, which these piles possess in a state of equilibrium, or which they communicate in a state of motion, are exactly and constantly proportional to the surface of the plates, whatever be in other respects the modifications that may arise in the course of the experiment, in consequence of the action of the pile itself. Messrs Gay-Lussac and Thenard have accordingly found, that the quantities of gas disengaged in a given time, are proportional to the surfaces of the plates which are employed; or, what comes to the same thing, to the total quantities of electricity. The same increase is observed in all the other chemical effects. A pile with large plates, though composed of a small number of pairs, is capable of burning several inches of iron wire; and if to the extent of the plates be joined also the augmentation of force which arises from their number, then the power becomes extreme. These phenomena of large plates were first observed by Messrs Hachette and Thenard. The action of the Voltaic apparatus, in the heating of bodies, is attended with this remarkable circumstance, that it produces the evolution of heat by its own energy, without the aid of any chemical combination. In this manner, as Sir Humphrey Davy has shown, the temperature of some bodies, plumbago for example, may be raised even to ignition, in the most perfect vacuum that can be produced; and not only raised, but preserved in this state for whole hours together, without losing any part of their weight. Whence then comes the heat which is thus continually disengaged? or from what inexhaustible source springs the torrent of light which is thus renewed as it flies off? These questions seem to be connected with the most recondite views of the nature of heat and light; and deserve all the attention of philosophers. Perhaps the electrical current, or rather the two opposite electrical currents which meet together, and neutralize each other's effect in the substance submitted to experiment, could be conceived to act on its particles by a compression or percussion, and to extract heat in the same manner as in the boring, or flattening of metals, or in the action of the hammer. But, indeed, we know as little of the nature of these latter phenomena as of the former; and when we consider the continued disengagement of heat which such processes occasion, and which has been produced in several experiments made by Count Rumford, we find as much difficulty in imagining the source from which the heat may arise in these circumstances, as in the opposite currents of the Voltaic apparatus.

On this subject an opinion of some boldness has been advanced, which, however, in our absolute ignorance concerning the nature of heat and light, ought not to be passed over in silence. It has been imagined, that the two electrical principles carry within themselves the principles of heat, and that the latter is disengaged at the moment of their reunion. This idea would, in fact, explain, in a very simple manner, all the phenomena of heat which the electromotive apparatus produces; and the progressive diminution of these appearances, when it is slow enough to be observed, seems to agree with it. For, if a trough apparatus, during the first moments in which it is charged, can bring to a red heat a certain length of iron wire, it will be found a few instants afterwards to be only able to redden a shorter length, and so on, until at last it becomes incapable of producing ignition in the shortest wire of the same diameter; and we then observe, that the portion of wire, which is reddened to whatever length it may be reduced, is always situated in the middle of the whole length, so that at one time the ignition is confined to a single spot in the middle of the wire, after which it ceases altogether in the middle.

At the period when every combination was attempted to form an electromotive apparatus entirely composed of dry substances, and consequently unalterable, Ritter of Munich discovered one, which, without the power of developing electricity by its own action, is yet susceptible of being charged by the voltaic pile, so as to acquire from it for a time all its properties. These have been named the secondary piles of Ritter.

To form a just and precise idea of this arrangement, we must take notice of an observation previously made by Mr Hermann of Berlin, on the imperfect conductibility of vegetable substances soaked in water.

If we insulate an electrical column, of which the superior pole is vitreous and the inferior one resinous, and make these two poles communicate by an imperfect conductor; such, for example, in the case of these small quantities of electricity, as a slip of paper moistened in pure water; each half of this slip will take the electricity of the pole with which it communicates, the superior part becoming vitreous, and the inferior resinous. This phenomenon is an evident consequence of the laws by which electricity is distributed among bodies that transmit it imperfectly.

Conceive now this imperfect conductor removed from the pile by some insulating body, as, for example, a stick of glass, and let it be so suspended in a dry atmosphere; then the equilibrium will not be instantly restored between its two extremities, but they will remain during some time vitreous and resinous as when they communicated with the two poles of the pile. These differences will diminish, by degrees, as the contrary electricities are recombined, and in a short time, their actions being neutralized, will become altogether insensible.

Such is precisely the case with the fundamental experiment of Ritter; only that for the moistened slip of paper, he substitutes a column composed of discs of copper and moistened cards intermixed. This column is incapable of itself of setting the electricity in motion; at least, if we suppose each species of its elements to be homogeneous in regard to each other. But it will charge itself by a communication with the pile, in the same manner as the slip of moistened paper above mentioned. There is yet an essential difference in the two results. Electricity, it appears, when weak, has some difficulty in passing from one surface to another. This seems, at least, the result of Ritter's experiments; and perhaps such resistance is itself produced by the imperceptible stratum of non-conducting air which adheres to the surface of all bodies. The electricity then introduced into the column constructed with a sin-

gle metal, passes, in like manner, with difficulty from each piece of metal to the preceding moistened card which is contiguous to it, and this obstacle increases in proportion as the alternations are more numerous. Such a pile, once charged, must therefore lose its electricity very slowly when there is no direct communication between its two poles. But if we form this communication by a good conductor, the escape of the two electricities, and their union together being very quickly effected, will produce a discharge which, in the same manner as in the leaden jar, will operate by an instantaneous shock. To this effect will succeed a new state of equilibrium, in which the repulsive forces of the different plates will be diminished in proportion to the quantity of electricity instantaneously neutralized. The discharges then must be repeated with diminished effect as we repeat the contacts, but will soon cease to be sensible, in consequence even of the equality of the charge which they tend to re-establish throughout the different parts of the apparatus. In a word, the action of this column resembles that which would successively take place with a more or less perfect conductor, according as its two extremities should communicate or not with each other.

As to the distribution of the electricity throughout the pile, it must be such, that the repulsive force of that portion which is at the surface of each plate, combined with the resistance of the adjoining surfaces, shall be in equilibrio with the united actions of all the rest of the plates; consequently, if we suppose the number of elements to be odd, and all the apparatus insulated, the quantities of electricity will go on diminishing from the two extremities where they are equal and of a contrary nature, as in the primitive pile, towards the centre where they vanish. But if the apparatus communicates with the ground at its base, the electricity will go on increasing throughout the whole extent of the column, from this base, where it will be nothing, to the summit, where it will be equal to that of the primitive pile.

The apparatus which we have described, produces, with diminished intensity, the decomposition of water, and the other physical or chemical effects obtained from the ordinary pile. By varying the order and the number of the discs of card and of copper, Ritter obtained various interesting results. In this manner, he observed, that of all the ways in which a number of heterogeneous conductors can be disposed, the arrangement in which there is the fewest alternations, is the most favourable for the transmission of electricity. If we construct, for example, a pile with sixty-four discs of copper, and sixty-four discs of moistened card, arranged in three masses, so that all the cards may form an uninterrupted series, terminated on each side by thirty-two metallic plates, this pile will conduct very well the electricity of the column of Volta, and will consequently be charged very little, if at all in a permanent manner. Interrupt now the humid conductors by a plate of copper, and the conducting faculty will already seem to diminish; more frequent interruptions will weaken it still more; and by multiplying them in this manner, we at last obtain a system in which the conductibility is scarcely sensible. Such are the phenomena which led Ritter to imagine that a weak electricity suffers some resistance in passing from one surface to another; a resistance which produces no effect except in this state of weakness; for by a singular property, a degree of electricity sufficiently powerful to overcome it, opens a perfectly free passage, and discharges itself entirely.

We have seen that, in changing the distribution of the elements in a secondary pile, its conducting faculty can be changed at pleasure; and it was natural to think that such modifications would variously influence the chemical and physiological effects produced. To examine the consequences progressively, Ritter varied the arrangement of a given number of humid and solid conductors, from the separation into two groups to the most numerous alternations. The following are the results which he has obtained.

A very small number of alternations gives a too easy passage to the electrical current of the primitive pile, if it be sufficiently powerful. The apparatus, then, is not charged in a permanent manner; and the chemical and physiological effects do not make their appearance. By multiplying the number of alternations, while the primitive pile remains the same, the secondary pile begins to be charged. It communicates electricity to the electrometer. It disengages from the water some bubbles of gas; but it gives no shock in human organs. The number of alternations increasing still more, the electrical charge increases, and we obtain the decomposition of the water, the shock, the spark, and the peculiar taste. But, at a certain limit of alternations, the chemical and physiological effects cease to increase, although the total electrical charge remains the same, or even continues to augment. Beyond this point, the charge is always produced; but the other effects decline. The disengagement of the bubbles ceases first, and afterwards the shock. We then arrive at the other extreme of a very imperfect conductibility; and the progression with which these phenomena are extinguished, the electrical charge remaining always the same, affords a final and conclusive proof of what we have above advanced regarding the manner in which they depend upon the velocity of transmission.

From the same principles, the reason will appear why the apparatus of Ritter is better adapted than any other for exhibiting clearly and distinctly these two kinds of action. In the ordinary pile, the quantity of free electricity increases with the number of plates, and balances the resistance which arises from the alternations; while, in the secondary pile, the repulsive force of the electricity at the two poles can never surpass that of the primitive pile; and the resistance which the alternations produce is wholly employed in modifying the discharge of the same quantity of electricity.

In fine, if the column of Volta is thus enabled to charge the secondary pile of Ritter, it owes this faculty to the circumstance of the repulsive force of the electricity at its poles being extremely weak,

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and nearly imperceptible. A more powerful electricity, such, for example, as that of the ordinary electrical machines, would pass entirely through the system of conducting bodies, which forms the secondary pile, and could not consequently produce any of the effects which result from its accumulation.

The differences which subsist in the chemical agency of ordinary piles, on account of the magnitude of their plates, occur also in the secondary piles. The nature of the cards, their thickness, the nature of the solution with which they are moistened; the order, in fine, in which we intermix them, and a variety of other trifling circumstances, modify these effects in a thousand different ways, which it would be equally useful and curious to examine.

The secondary pile being, as we have mentioned above, formed with a single metal and a moistened substance, would seem, at first sight, incapable of possessing electricity of itself; and its own action, in fact, before we have charged it, is scarcely perceptible. But it may yet commonly be rendered sensible, by bringing the muscles and the nerves of a frog in communication at their two extremities.

By considering the process by which the electricity, developed by our machines, discharges itself through bodies of different kinds, we find, that those which seem to conduct it best, still oppose to its passage a sensible resistance. Hence, it is to be conceived, that if we could attenuate sufficiently the energy of the electricity, without losing, at the same time, the possibility of recognising its presence, we should obtain for every body, and even for the best conductors, certain limits, at which the transmission would become very slow, or would cease altogether to take place. The electromotive apparatus, furnishing an inexhaustible source of electricity, with a repulsive force, which may be rendered extremely feeble, unites all the conditions the best adapted for this kind of research. It has, accordingly, led to the discovery of various phenomena in the conducting qualities of liquids, with which our ordinary electric machines could never have made us acquainted.

In applying himself to inquiries of this kind, Mr Hermann of Berlin has made this very curious observation, that the conducting faculty of certain bodies for the two electricities is unequal; so that by attenuating more and more the repulsive force, we obtain a limit where the body becomes insulating as to the one electricity, while it still remains a conductor of the other. This is proved by the experiments which we are now to relate.

Mr Hermann insulated an electromotive apparatus, constructed with a good liquid conductor, such, for example, as the solution of the muriate of soda. He made each of its poles communicate with a very sensible gold leaf electrometer, equally well insulated. The leaves of each of the electrometers soon acquired the degree of divergence determined by the number of plates, and the electrical zero was found in the middle of the apparatus.

This being done, he took a prism of alkaline soap, and inserted in one of its ends a metallic wire communicating with the ground. He then touched with the other end, any one of the poles of the pile, and this pole was immediately discharged. The divergence of the electrometer was reduced to nothing, and the electrometer of the other pole diverged more than before. Everything happened as if the pole, which was touched by the prism, had communicated with the ground, and the soap seemed to act as a conductor to either electricity indifferently.

The pile remaining always insulated, and the repulsive influences of its poles being restored, he made these poles now to communicate together through the medium of the same prism of soap, by inserting into the two ends of it the metallic wires proceeding from each pole. In spite of this communication, the two electrometers continued to diverge as before, so that the soap now seemed to act as a non-conducting body.

But when this insulation was distinctly recognized, he touched, for an instant, the soap with a wire of metal which communicated with the ground. Immediately the resinous pole was neutralized, and the repulsive force of the vitreous pole attained its maximum. Thus, the soap assumes anew its conducting faculty, but only to allow the efflux of the resinous electricity, which it always transmitted in preference. Even if we touch it quite near to the wire, which proceeds from the vitreous pole of the pile, this pole remains no less insulated on this account.

The flame of alcohol presented to Mr Hermann similar effects, but the conducting disposition was in favour of the vitreous electricity. All this, however, only refers to very slight degrees of electricity, such as the electromotive apparatus affords; for both the flame of alcohol and soap conduct, imperfectly no doubt, but in a manner sensibly equal, more powerful degrees of electricity.

By repeating these experiments, Mr Biot recognized a property in sulphuric ether, which completes those discoveries of Mr Hermann. This liquid, interposed between the two poles of the pile, seems to insulate them like soap and the flame of alcohol. If we place it in the circuit of the apparatus for decomposing water, it will not disengage any bubbles of gas. And, in fine, all the signs of the insulation of the two poles make their appearance. But if we touch the ether for a single instant with a metallic wire, to make it communicate with the ground, applying, at the same time, a condenser to any of the wires of the pile, this condenser will be completely charged, as if the ether had all of a sudden became a conductor of the electricity belonging to the pole to which the condenser is applied. In describing these experiments, we have said that the two poles of the pile *seem* to be insulated by the interposition of a prism of alkaline soap. The insulation is, in fact, only partial; the motion of the electricity in the prism of soap is not altogether extinguished; it is only slower than in the pile itself, which allows the latter to be sensibly recharged, and to acquire a tension at its poles, while the soap is discharging it. In proof of this, it may be observed, that the same prism of soap conducts absolutely the whole electricity of a less conducting pile, such as that with paste; it takes away all tension from its poles, and the condenser is hence no more charged in touching them. The flame of al-

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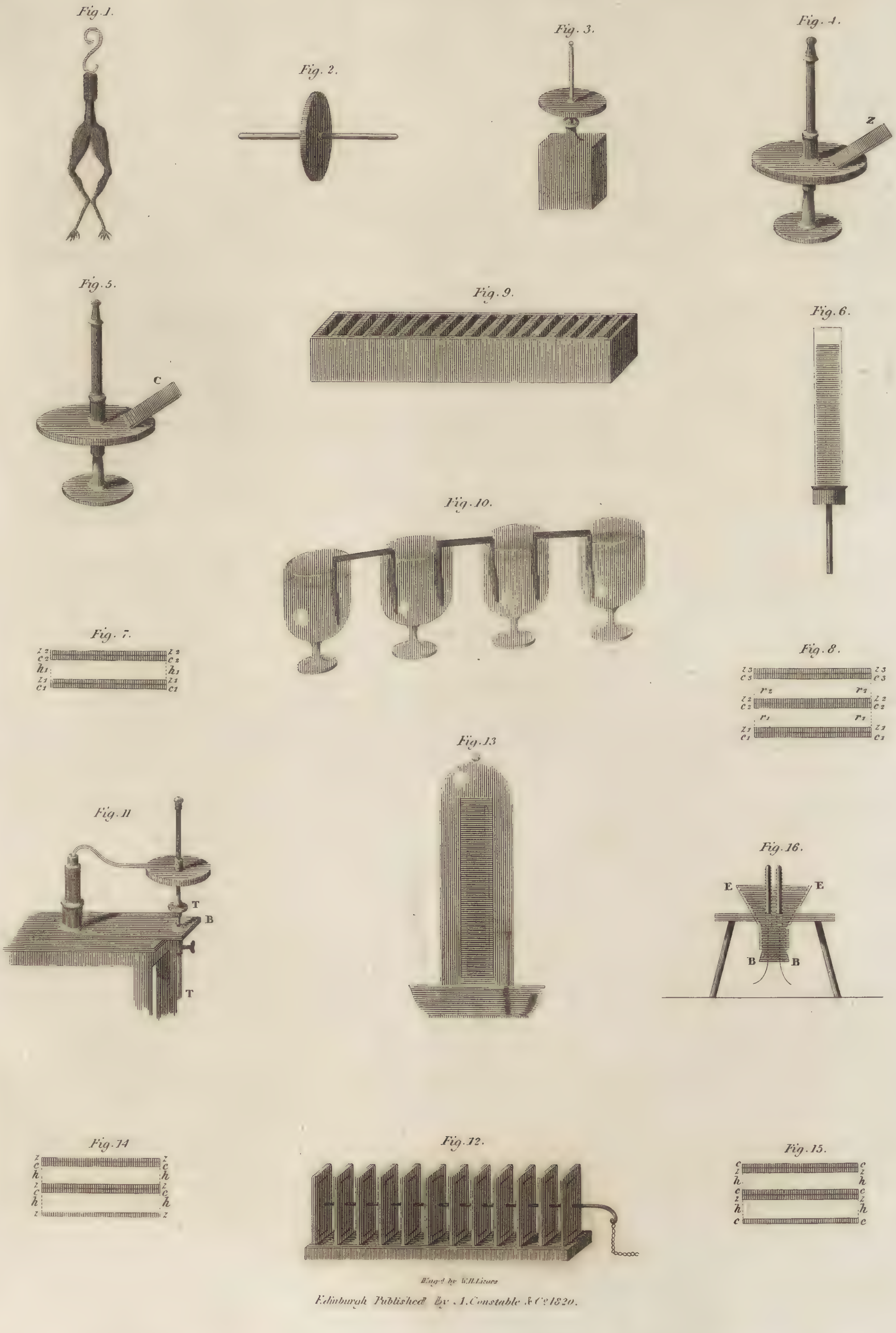
*PLATE LXXX**.



Engd by W.H.Lizars

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cohol interposed between the poles of this same pile does not discharge it completely; it leaves a tension remaining at its poles, and we can repeat with it the experiments of Mr Hermann. This flame, then, does not conduct the electricity so well as the alkaline soap.

From the details which we have given in this article, it appears that the electromotive apparatus may be considered, as producing by the mutual contact of the heterogeneous bodies which compose it, a developement of electricity, which is propagated and distributed through its interior by means of the conductors interposed between its metallic elements. If we form a communication between its two poles, the discharge which follows, overturning the state of electrical equilibrium in the series of bodies superimposed on each other, causes them to be recharged according to the conditions of this equilibrium, either at the expence of the ground, or by the decomposition of their natural electricities. The repetition then of such discharges, or rather their continuation, must occasion in the apparatus a continued electrical current, the energy and the quantity of which depend as well on the magnitude and the nature of the metallic elements in contact with each other, as on the greater or less facility which the conducting parts of the apparatus present to the transmission of electricity. Setting out from these primary notions, we have described the most favourable arrangements for obtaining from the Voltaic apparatus each of the electrical, physiological, and chemical effects which it is capable of producing; and we have confirmed our views of the subject by relating those experiments, which prove them to be conformable with the actual fact. The general result of these researches has shown, that the action of this apparatus depends on two elements, of which the one, constant in its energy, consists in the electromotive faculty of pieces of metal, and the other, which is variable, depends on the more or less perfect conductibility of the bodies interposed. The first of these elements has been fixed by Volta, by help of experiment, and in a manner which seems to us to leave not the smallest doubt of the fact. But the second, in the variety almost infinite which belongs to it, presents to the researches of philosophers a field for an infinity of experiments, the results of which, enabling them perhaps to augment still farther the power of this instrument, may furnish extremely curious data as to the conditions which determine the easy or difficult passage of electricity through bodies; as to the manner, hitherto unknown, by which it attaches itself to their particles; and, perhaps also as to the nature of electricity itself, or at least the condition in which the principle that produces it exists in bodies.

Since this article was written, a young French philosopher, Mr Becquerel, has made a series of extremely curious experiments, in regard to the production of electricity by compression. He forms very slender discs of any substances,—insulates each of these discs at the extremity of a tube of glass, or of resin well dried, and taking one of these tubes in each hand, presses against each other two of the discs, of a different nature, and withdraws them from their contact in opposite states of electricity; the one becomes vitreous and the other resinous. This phenomenon must not be confounded with the developement of electricity by simple contact, such as Volta made use of in his excellent researches. It is incomparably more powerful with almost all substances: A single pressure is sufficient, in ordinary cases, to drive off with rapidity the moveable disc of the electrometer of Coulomb (see Electricity, *Supplement*); and the repetition of several pressures is sufficient to charge powerfully and directly, an ordinary electroscope with gold leaves, without the aid of the condenser. Cork, bark, hairs, paper, and wood, produce these phenomena with a very high degree of intensity. The same takes place equally well with most of the minerals. Some bodies appear to have the property of reacting on themselves, when electrified in this manner. They decompose their own electricities; and these, once developed, fix, by their influence, that which is disengaged at their surface. In a word, these bodies act, in reality, unto themselves like condensers; so that we may take them in the hand, or even moisten their surface without depriving them of their electricity. No substance possesses this faculty in a higher degree than the rhomboidal carbonate of lime; and, indeed, Mr Hauy has long since found, that it is sufficient to press slightly between the fingers a crystal of this mineral, to cause it assume a very powerful state of electricity, which it then preserves with obstinacy for hours, and even for whole days, without requiring any renewal. Mr Becquerel has also found that many minerals may be electrified by mere exfoliation. A thin leaf of mica, for instance, if separated into two others, held by two insulating tubes, these two are found to possess, in a high degree, the opposite states of electricity; the one is resinous, the other vitreous; and many substances which are incapable of producing this opposition, when exfoliated at the common temperature, acquire this property when they have been moderately heated. (z. z.)

GALWAY, a county in Ireland, situated in the province of Connaught, within the archbishoprick of Tuam, is bounded on the north by Mayo, on the east by the river Shannon, which separates it from King's County and Tipperary, on the south by Clare, and on the west by the Atlantic Ocean. In extent it is next to Cork, the most considerable in Ireland, and contains 2593 English square miles, or 1,659,520 acres, divided into seventeen baronies, and, including the South Arran Isles, three in number, at the entrance of Galway bay, into one hundred and sixteen parishes.

Extent and Divisions.

Surface.

The surface of this extensive district presents great variety and contrast. More than a third of it consists of bogs, mountains, and lakes, and is very thinly inhabited and unproductive. The greater part of

Galway.

this tract is contained in three baronies, on the west side of the county. On the east and south the country is generally flat, though not without a few hills of no great height, and the soil is warm and fertile, incumbent on limestone; yet much of it is better adapted for grazing than tillage; and the dry stone walls, with which the fields are inclosed, and the want of trees, give it a rather dreary aspect. This part of Galway contains more gentlemen's seats than any other district of the same extent in Ireland, though few of them are remarkable for their magnificence. Lough Corrib, which, in some measure, marks the boundary between these two divisions, extends about twenty miles in length, its greatest breadth being eleven miles; but in the middle it is contracted to a narrow channel, which is crossed by a ferry at Knock. The country which reaches from the sea to the Shannon, is well watered by rivers, and contains also several beautiful lakes. Next to the Shannon, the principal rivers are the Suck, the Black River, Clare, Galway, and Dunmore. Some of these are subterraneous in a part of their course; the Black River, on the bounds of Mayo, dips for about three miles, and the Clare and the Moyne unite their waters under ground, alternately appearing and retiring from view. Lough Reagh and Lough Coutra are fine pieces of water; the latter, in particular, which is situated near the borders of Clare county, is said to possess all the beauties that hills, woods, and islands can impart to water.

Rivers.

Estates.

Among the landed proprietors of Galway, there are several who hold large estates, affording an income of from L. 5000 to L. 10,000 a year, and upwards. One of these estates, the most extensive in the British Isles, stretches along the sea coast for 70 miles. Only a small portion is held by absentees. In 1809 the rent of the green land averaged from a guinea and a half to two guineas *per* acre, or about 22s. 9d. the English acre. A full third of the land is let on partnership leases, to an indefinite number of persons, very often twenty, who by law are joint tenants, and entitled to the benefit of survivorship. The leases are commonly for three lives or thirty-one years. "These people," says Mr Wakefield, "divide the land and give portions to their children, which consist of a fourth or a fifth of what they call 'a man's share,' that is, of the land which originally belonged to one name in the lease. A certain portion of the whole farm, or *take*, as it is styled, is appropriated for tillage, and this portion is then divided into lots, perhaps twenty or thirty. These lots are again subdivided into fields, which are partitioned into small lots, each partner obtaining one or two ridges; but these ridges do not continue in the hands of the same occupier longer than the time they are in tillage. The pasture is held in common; and the elders of the village are the legislators, who establish such regulations as may be judged proper for their community, and settle all disputes that arise among them. Their houses stand close to each other, and form what is here termed a village."

Rent.

Partnership Leases.

Live Stock.

The cattle of Galway are long-horned, and of an excellent description, fully equal, in the opinion of Mr Wakefield, to any in England. But sheep form the most valuable part of their live stock; "some of the finest flocks in the world," says the same writer, "are to be found in this county." The crops are the same as in other parts of Ireland, but potatoes are not cultivated to so great an extent. They plant potatoes on an oat stubble, or on lea that has been burned or manured, and follow with wheat, bear or barley, or oats; the latter kind of grain is not unfrequently taken after wheat and barley. Paring and burning the soil is very common. The greater part of the rent of some of the estates on the shore is paid from kelp, which is prepared in large quantities.

Crops.

Manufactures.

In common with the greater part of Ireland, Galway employs some of its people in the linen manufacture, and it seems to be the only kind of manufacture in it worth notice. At the town of Galway there is a considerable salmon fishery, and in the bay of that name herrings and other fish are caught in quantities more than sufficient for the supply of the inhabitants. Lobsters and crabs abound on the shores of the bay; such as in Dublin would bring 7s. or 8s. may be often bought there for 6d., and sometimes for even less. The oysters found at Pouldoody have long had a high reputation, and are much sought after in Dublin. In Lough Corrib there is a fresh water muscle that produces pearls, "of which," says Beaufort, "I have seen some very fine specimens." The number of men enrolled as sea fencibles, which comprehended all the fishermen of Ireland, was for this county 452, nearly the medium of all the maritime counties of Ireland.

Towns.

Among the towns, the principal is Galway, which, though situated on a bay, sheltered by the Isles of Arran, and having a safe harbour, with a sufficient depth of water, has, nevertheless, very little foreign trade. Its population has been stated conjecturally at about 15,000. It is the only Parliamentary borough. Tuam is a place of some note, containing the Archbishop's palace and the remains of several religious houses, said to be of great antiquity. Ballinasloe is a well-built, thriving town, pleasantly situated on the western bank of the river Suck. Here the greatest fairs in Ireland, for sheep, cattle, and wool, are held in July and October. In the lower districts, there is a number of villages, but none of them considerable.

Wages and Prices.

According to Mr Wakefield, the wages of common labour, in 1811, were 9d. a-day; and, in hay and corn harvest, 1s. 1d. The price of potatoes was $3\frac{1}{2}$d. *per* stone; beef $5\frac{1}{2}$d., and pork $3\frac{1}{2}$d. *per* lb.; oatmeal 14s. *per* cwt.; milk 2d. and butter-milk $\frac{3}{4}$d. *per* quart; and herrings 5s. 3d. the hundred.

Representation.

The county sends two members to Parliament, and the borough of Galway one. The landed property of the Roman Catholics returns the members for the county; but there is no commanding territorial influence. The freeholders amount to 4000. The borough is said to be under the influence of two gentlemen of the name of Daly, who return the member alternately.

Arran Isles.

The Arran isles, which form a part of this county, are of considerable extent, having a rocky surface, and a precipitous coast, which, in many places, shoots up into stupendous cliffs. They are inhabited by a hardy race, who, like the people of the

Galway || Garve.

western islands of Scotland, are at one season of the year fishermen, and at another husbandmen. The cavities and fissures on their coast are the resort of great numbers of sea fowl, which are caught for their feathers, by men suspended by a rope from the summit of the precipice. The flesh of the small sheep of these islands is highly esteemed for its taste and flavour. On a high cliff projecting into the sea, in the island of Arranmore, there is a circle composed of very large stones, piled up without cement, called Dun Angus; and, in the same island, there is said to have been an abbey, which was burnt early in the eleventh century. These islands are called South Arran, to distinguish them from an island of the same name on the coast of Donegal. They gave the title of Earl to the Butler family, lately extinct; it is now in the family of Gore. In 1313, they were pillaged and burnt by Sir John D'Arcy, Lord Justice of Ireland. Of the other islands on this and some other parts of the Irish coast, little is known to strangers, as they are only noticed incidentally, when noticed at all, by the latest writers on Ireland.

Population. According to Beaufort, the population of Galway, in 1792, was 142,000; and the number of houses, by the returns of Mr Wray, Inspector-General of Hearth-Money, was, in that year, 24,268, of which more than a fourth were exempted from the tax. In 1809, the Catholics were, to the Protestants, as 40 or 50 to one. In the western parts, there are districts of 50 miles, perhaps, in extent, where there is neither a church nor a single Protestant inhabitant. The Militia are nearly all Catholics: and ten Catholics are called on the Grand Jury. The Protestant population seems to be stationary; but, in several parishes, the increase of the Catholic, in 15 years before 1811, is stated to have been as $5\frac{1}{2}$ to 7. In the town of Galway, the services of the Catholic Church are performed by the priests in the Irish language. —See the works formerly referred to under the Irish counties. (A.)

GARVE (Christian), an eminent German Philosopher and Essayist, was born on the 7th of January 1742, at Breslau, where his father exercised the trade of a dyer. He studied at the universities of Frankfort, Halle, and Leipsic; at which last place he obtained a professorship of philosophy, but was soon compelled to resign it, in consequence of bad health. He returned to his native town, where he continued to spend the remainder of his life in retirement. In his last years, he suffered much from a painful and incurable disease, which he endured with the most philosophical fortitude. He died at Breslau on the 1st of December 1798.

The character of Garve was exceedingly amiable, both as a man and a philosopher. His erudition was great; and his writings bear witness both to the extent of his knowledge, and the accuracy of his judgment. The celebrated Kant paid him the compliment of saying, that he was "a true philosopher, in the legitimate acceptation of the word."

Garve.

Garve invented no system of his own, nor did he attach himself to the tenets of any one master. He belonged to that class of philosophers, who, without adopting any particular theory, take an impartial view of all systems of doctrine, and seek truth wherever it is to be found. The just and rational views which he inculcated on the subject of our moral and social duties, entitle him to the praise of a genuine practical philosopher. The history of philosophy is indebted to him for several new and ingenious illustrations; and he has left us a faithful though rapid sketch of the ancient and modern doctrines respecting the fundamental principles of moral philosophy. His literary essays display a refined taste, and a genius at once elegant and philosophical. His style is uniformly simple, perspicuous, and correct.

The principal works of Garve are, 1. *Dissertatio de nonnullis quæ pertinent ad logicam probabilium*, 1766, 4to. 2. *Dissertatio de ratione scribendi historiam philosophicam*. 3. A Prize Essay, in German, *On the inclinations*, which was crowned by the Royal Academy of Berlin, 1769, 4to. 4. *Progr. legendorum philosophorum nonnulla et exemplum*, 1770, 4to. 5. *Remarks on the character and writings of Gellert*, 1770, 8vo, in German. This treatise was translated into French, and inserted in the French translation of Gellert's works by Pajon. 6. *A dissertation* (in German) *on the union of morals and politics*, Breslau, 1788, 8vo; also translated into French. 7. *Essays* (in German) *on various subjects in literature, morals, and social life*. Of these, three volumes, we believe, were published during the author's life, and two have been added since his death. These volumes contain, among others, his Essays *On society and solitude; On the existence of God;* and his beautiful Treatise *On patience*, which he is said to have dictated on his death-bed. 8. *A sketch* (in German) *of the most remarkable principles of moral philosophy, from the time of Aristotle to the present day;* which was first prefixed to his translation of Aristotle's *Ethics*, and afterwards printed separately; Breslau, 1798, 8vo. 9. *Some observations on the most general principles of morals*, in German, Ibid. 1798, 8vo. Besides these works, Garve wrote a number of literary essays, which were inserted in various periodical publications. He also translated into German a variety of works, particularly from the English; many of which he enriched with valuable notes. Among these, we may notice the *Ethics, Rhetoric, and Politics* of Aristotle; Cicero's *Offices;* Burke *On the Sublime and Beautiful;* Smith's *Wealth of Nations;* Fergusson's *Principles of Moral Philosophy;* and Paley's *Principles of Morals and Politics*. Garve's *Correspondence* with Weisse, and some other friends, was published at Breslau, in 2 vols. 8vo.

See the *Biographie Universelle*, Tom. XVI. Art. Garve, by Degerando. (H.)

GAS-LIGHTS.

Gas-Lights. History.

Though the application of Gas-Lights to economical purposes is of recent date, a considerable time has elapsed since the public were, in some degree, made acquainted with the properties of the gas hitherto principally made use of for such purposes, and which is commonly known by the name of coal gas. The inflammable properties of gas, escaping from the surface of a spring in the neighbourhood of Wigan, in Lancashire, are described in the *Philosophical Transactions* for the year 1667; and in the volume for 1733, there is an account of the carbureted hydrogen, issuing from a coal-work in Cumberland, having been collected in a bladder, and burnt through a tube attached. In 1739, the Reverend John Clayton distilled coal in a close retort, and obtained therefrom a black oil, and a permanent gas (or spirit, as he calls it), and which latter he confined in bladders, and burned it through small orifices. There are other notices of burning wells and burning rocks, and of inflammable air having been found to arise from the distillation of coal, and of gases differently produced having been used for fire-works; but it does not appear that the idea of applying the light produced to useful purposes occurred to any person till the year 1792, when Mr William Murdock, of Soho, employed coal gas for the purpose of lighting his house and offices, then at Redruth, in Cornwall. The gas was generated in an iron retort, and conveyed in tubes to different situations, from whence it issued through proper apertures, and was there inflamed. Portions of the gas were also confined in portable vessels of tinned iron, and other substances, from which it was expelled when required, furnishing a moveable gas-light.

From this time forward, till about the year 1802, little more appears to have been done towards introducing this discovery to public notice. In the interval, however, Mr Murdock had made a number of experiments on the subject, and lighted up part of the manufactory at Soho; at which place a public display of the gas-lights was made in the spring of 1802, upon occasion of the general illumination for the peace then concluded at Amiens.

It has been asserted, that gas-lights were used in Paris previous to the British public being acquainted with them. The earliest date, however, assigned for their appearance is the winter of 1802: the gas used appears to have been obtained from wood.

In the years 1803 and 1804, gas-lights were exhibited in London; but a considerable time elapsed, and large sums of money were expended, before the metropolis was any way benefited by the introduction of Mr Murdock's discovery.

The first application, upon any considerable scale, of lighting by means of coal gas, was to the extensive cotton-mills of Messrs Philips and Lee of Manchester; the apparatus employed was erected in 1804 and 1805 under the directions of Mr Murdock, and it was found capable of supplying light equal nearly to what 3000 candles would yield. This system of lighting was shortly after adopted by many proprietors of cotton, woollen, and other manufactories in different parts of the kingdom, and has since been gradually introduced into most of the principal towns; and in America and on the Continent it appears to have been partially adopted.

Gas-Lights.

About the year 1804, Mr Winsor, who had first exhibited the gas-lights in London, took out a patent for preparing and purifying coal gas; and, since that time, numerous others have been granted for effecting similar purposes; but, in general, their claims to novelty and utility are very limited.

Gases obtained from other combustible substances have been used for the purposes of affording light. Tallow, pitch, turpentine, turf or peat, some of the resinous woods and barks, all yield gases more or less fitted for the purposes of illumination; but with regard to the comparative economy of each, it does not appear that accurate results have been obtained from experience. Oil-gas has been extensively used, and will be treated of.

Apparatus requisite for preparing Coal Gas in a state fitted for the purposes of Illumination.

When pit-coal is made to undergo destructive distillation in a close vessel or retort, the products will, in general, be found to consist of the following substances; though, from the varying nature of the coal, they do not all exist in every species, some of them at least but very sparingly:

- Coke or Charcoal.
- Tar and oil, two or three varieties.
- Water.
- Ammonia, partly as hydrosulphuret, and partly as subcarbonate.
- Carbureted hydrogen gas.
- Olefiant gas.
- Sulphureted hydrogen gas, besides portions of carbonic acid, of hydrogen gas, and common air; and also azotic gas, especially towards the end of the process.

General Process.

The construction and management of the retort will naturally come first under consideration; and in tracing the progress of the liquid and gaseous products, the condensing, collecting, and disposal of the latter come next to be treated of. The purification of the mixed gases, after they are separated from the tar and other liquids, forms an important subject of inquiry; and subsequent to which, the preservation of the purified gas in proper receptacles will be treated of. Its distribution to places where lights are required will then follow; and, lastly, a view of some facts relative to its combustion under different circumstances will complete this part of the subject.

Gas-Lights.

The Retort.

Of the Retort.

The retort first employed by Mr Murdock was made of cast-iron, and of a cylindrical form. See Plate LXXXI. fig. 1, where it is represented, as inserted into a common portable furnace : *a*, the retort; *b*, its cover made air-tight by luting; *c*, the tube or branch-pipe to convey away the gas and other products. This retort, being about two-thirds filled with coal, was submitted to the action of the fire; and, on its acquiring a red-heat, the decomposition of the coal commenced; the tar, oil, and gaseous products escaping through the tube *c*, and the charcoal or coke remaining behind in the retort.

It is obvious, that this form of retort is inconvenient, as regards the removal of the coke at the termination of each process, and, to remedy such inconvenience, a different construction was adopted, and which we saw in use as early as the year 1802. Of this a representation is given in fig. 2; *a a*, the retort, consisting of a cylindrical vessel placed horizontally, with a door or cover *b*, to charge and discharge it of its contents, and branch pipe *c* to convey away the products of distillation; *d* the grate; the flues were so constructed that the flame surrounded the retort and afterwards made its escape at the chimney *e*. Retorts on this construction, from twelve to twenty inches diameter, and from three to seven feet in length, were found to answer tolerably well, and could be charged and discharged with facility.

Figures 3 and 4 represent the other varieties which we observed in use in the years 1804 and 1805. The peculiarity of these consists in their having each two openings or doors *b* and *f*, the first to admit the coal, and the other to allow of the discharge of the charcoal; *a*, *d*, *c*, refer to the same parts as in fig. 2. These retorts are necessarily more costly than those having only one opening, and they were, on the whole, found more troublesome to manage and keep in order.

Fig. 5 is a representation of one of the retorts first used at the works of Messrs Philips and Lee, which differs little from fig. 1, except in magnitude, being made to contain about 15 cwt. of coal, while the other would hold only about the same number of pounds. The grate, flues, and chimney, and general construction, require no particular explanation, the letters referring to the same parts as in fig. 2. In order to facilitate the discharge of the cokes, an iron cage *e*, figured separate in the plate, formed somewhat like a grappler, was let down into the retort previous to its being charged with coal; and when the process of distillation was completed, the grappler was lifted out by means of a small crane, carrying the mass of charcoal along with it. Another grappler being then introduced, a fresh charge of coal was thrown in, and the process of distillation carried on with very little interruption. The quantity of gas produced from each cwt. of good common coal, obtained in the neighbourhood of Manchester, was from 330 to 360 cubic feet, when these retorts were employed, each yielding it at the rate of 160 cubic feet *per* hour on an average. The quantity of gas, however, varied considerably with the temperature at which the process was carried on; and the rate at which it was produced diminished greatly after the expiration of a few hours from the commencement of the distillation.

It is sufficiently obvious, from the construction of this retort, that, upon its being charged with fresh coal, and already of a red heat, the process of carbonization will proceed most rapidly at first; a crust of coke being speedily formed next to the heated metal, and this constantly increasing in thickness, prevents the free transmission of the heat, and the decomposition of the coal is consequently retarded more and more as the crust increases in thickness. As a remedy for this evil, and to which all the above forms of retort are liable (unless made of extremely small capacity, and thereby unfitted for practical use); one of the shape represented in fig. 6 was constructed, having an illiptical cross section, as shown at *e*, and placed, as regards the grate and brick-work, much in the manner of fig. 2, the letters referring to like parts. When filled about half full of coal, and previously brought to, and afterwards kept at a strong red heat, the quantity of gas produced was about 30 *per cent.* more than what the retort fig. 5 yielded, and the illuminating power, bulk for bulk, considerably increased. And the result of a great number of experiments, continued for a length of time, and under the varying circumstances of rapid and slow distillation, and large and small masses of coal, showed decisively, that the greater the rapidity with which the distillation was effected, the greater was the quantity of gas produced (from an equal weight of coal), and the more intense the illuminating power of that gas, volume for volume. The quantity of liquid product was also lessened, and the weight of the residual charcoal not so great as when the process was conducted with less rapidity.

The most advantageous results were obtained when the retort was heated to a *bright* red heat; when increased much beyond this point, so as nearly to approach a white heat, the production of gas was materially lessened.

We witnessed the above experiments, which were made at Soho, in 1807, and, as their results are of the first importance, the particulars of one series are given in the following table. The coal made use of was from the neighbouring collieries in Staffordshire, and of inferior quality, but that circumstance does not affect the comparative results of the experiments. The best Staffordshire coal will yield about 530 cubic feet of gas from each cwt.

No. of Experiment.	Time of Distilling the Coal.	Cubic Feet of Gas produced.	Weight of Coke.		Weight of the Tar, Water, and Oils.		Time which the Gas supplied the Light of one Candle.
	Hours.		lbs.	oz.	lbs.	oz.	Hours.
1	3	41.3	8	8	2	3	115
2	7	37.5	8	8	3	1	86
3	12	33.5	8	13	–	?	78
4	25	31.7	0	9	3	3	69

The above table gives the results obtained from 56 lbs. of coal. This quantity was broken into small pieces, and mixed so as to render any portion of it of equal quality with the rest; it was then divided into four equal parts, each weighing 14 lbs., and these submitted separately to the action of the fire. In experiment No. 1, the retort was heated so as to complete the distillation in three hours; in No. 2, seven hours, &c. as specified in the second column. The third column gives the number of cubic feet of gas obtained in each case; the fourth, the weight of the charcoal remaining in the retort; and the fifth, that of the liquid products: the last column shows the number of hours which each portion of gas supplied the light of one candle; and these numbers are, therefore, expressive of the comparative value of the gas obtained in each experiment from an equal weight of coal. Generally, it was observed, that, in keeping these elliptical, or other flat-shaped retorts at a bright red heat, and introducing the coal into them when in that state, the quantity of gas was increased from one third to one-half (compared with what the retorts fig. 5 yielded); the time of distillation greatly shortened; and the quality of the gas much improved; giving results, on the whole, not less favourable than those particularized in the above table.

The degree of heat, however, which was found to be most advantageous for the production of gas, was very destructive to the cast iron of which the retorts were formed; and to preserve these from rapid oxidation, their lower sides were made to rest upon thin firebricks, as represented in fig. 7, where the section of the retort is varied somewhat from the figure of an ellipse, as shown at *n*, to apply with greater exactness to the upper side of the protecting bricks *g g*; *i i*, other bricks set on end to support the former, and standing upon an arch *f*, over the fire place; the flame, rising through the opening, *e*, and circulating at *h h*, underneath the bricks *g g*, escapes through two side flues, one of which is shown at *k*; and, after rising and passing over the top of the retort, enters the chimney: *a*, *b*, *c*, *d*, refer as in the former figures.

A somewhat simpler arrangement is shown in fig. 8, where the under side of the retort *a* is curved upwards, so as to apply directly to the back of a thin fire-brick arch, *e*, through which the heat is transmitted. The flame from the fire *d*, after acting against the brick arch, divides and escapes through the flues, *f f*; and, after uniting again at the upper side of the retort, ascends into the chimney. The conducting pipe is here shown issuing from the lower part of the door-piece *b*, and descends, instead of rising or passing away in a horizontal direction, thereby lessening its liability to be choked up by tar condensing therein.

This construction of retort is probably not inferior to any that has been used. When made of the dimensions represented (being drawn to a scale of one-fourth inch to the foot) it will contain about one cwt. of coal, when somewhat more than half filled, and produce gas at the average rate of 100 to 150 cubic feet *per* hour, according to the nature of the coal employed. With proper attention, it will work off six charges of coal in 24 hours; and last, when in constant use, from nine to twelve months.

The first description given to the public of an apparatus for producing coal gas for useful purposes, appears to have been in 1808, by Mr Samuel Clegg, in a paper transmitted to the *Society of Arts*. He therein describes a retort similar to fig. 2 in form, and protected from the immediate action of the fire by an interposed curved plate of iron. This cylindrical figure has been generally adopted at the gas works in the metropolis, and those of many provincial towns. Elliptical ones, similar to fig. 6, have, however, lately been introduced into the Westminster works; and, though much superior to the former, are yet less perfect than that shown in fig. 8, a construction which has been extensively used since the year 1808 in the northern manufacturing districts of England, and in Scotland.

Retorts, having for their vertical section a square or parallelogram, are also used (figs. 9 and 10), and these, as well as those of the cylindrical and elliptical shape, are occasionally placed so that two or three more are heated from the same fire; or a number of retorts, arranged with fires common to all. Figs. 11, 12, 13, 14 exhibit varieties of these; all, however, are liable to the objection that, when any retort becomes useless, those connected with it require to be stopped and disused during the time the faulty one is replacing. Constructions have been proposed which should admit of these repairs without causing interruption; but there is no great appearance of practicability in any plan for this purpose hitherto made public. When a number of retorts have to be heated from the same fire, any thing like regularity of temperature is difficult to obtain, on account of the different distances at which they must be placed from the source of heat; and, on the whole, except the circumstance of saving a little room, the plan has nothing to recommend it.

The fuel necessary to decompose any given quantity of coal may generally be stated at about one-third of its weight. There are statements published where less than one-fourth is mentioned as sufficient; but, where the retorts are to be kept at a proper, or bright red heat, so as to be capable of producing the largest and best supply of gas, less than one-third cannot be reckoned upon with certainty; and, as inferior coal is frequently used for fuel, the proportion may, in such cases, amount to, or even exceed, one-half the weight of the coal to be distilled.

It would much exceed our limits to notice every variety of retort which has been proposed. It may yet, however, be proper to notice another device for which the last person named obtained a patent, three to four years since. An outline of this machine, comprising an horizontal and vertical section, is drawn in fig. 15; *a*, *a*, *a*, *a*, is a flat cylindrical vessel of iron, having an aperture, *b*, at one side, and door to close it. In the centre is a vertical spindle, *c*, carrying a number of horizontal arms, *d d*; *e* is a representation of a pan or vessel for containing the coal, and with one of which each arm, *d*, is furnished. About one-third part of the lower and upper surface of the vessel, *a a*, is exposed to the action of a fire, *f*, and

kept red hot; the flues, *g g*, conducting the flame to the chimney, in the manner shown in the figure; and the pans of coal (being, by means of the aperture *b*, introduced upon the arms *d d*) are brought in succession over the heated part, and there lowered, so that they may rest upon the red hot surface. The distillation is thus carried on, and, when completed, the axle is turned partially round, and another pan, or set of pans, exposed to heat in the like manner. This is a complex and expensive apparatus; and, inasmuch as the coal is not brought into immediate contact with the red hot surface, it must necessarily be inferior in performance to the elliptical or other forms, figs. 6, 7, 8; and, though there are statements before the public which represent the results in a very advantageous light, these must be received with caution. It is mentioned,* that, by the use of this retort, 16,000 cubic feet of gas, and upwards, may be obtained from one London chaldron of Newcastle coals, being 590 cubic feet to the cwt.; and that the same weight of coal distilled in a cylindrical retort will not give more than 370 cubic feet to the cwt. By using flat elliptical retorts, however, and exposing the coal in very thin layers, upwards of 600 cubic feet have been obtained; and, for general practice, where the coal is of good quality, 500 to 550 cubic feet may be calculated upon as the product of each cwt.

The quantity of gas which one chaldron of Staffordshire coal yielded, when distilled in the retort last described (fig. 15), was, according to Mr Accum, 11,000 cubic feet, or about 400 to the cwt. This falls much short of what has already been stated as the product of the best coal from that district.

A retort constructed so that the coal (broken small) could be exposed in very limited quantities at once to the action of the fire, and, at the same time, scattered so as to cover a large surface of the heated vessel, would be desirable. The constant charging and discharging of such a retort, however, where each process of distillation would be completed in a few minutes, is a serious objection. Forms have been devised for effecting these ends during the carbonization of a number of successive portions of coal, without opening the doors of the retort; but the internal machinery requisite for this purpose is liable to derangement and uncertainty of action, owing to the great heat it must necessarily be exposed to. We have not hitherto seen or heard of any constructions wherein the requisites of simplicity, durability, and certainty of effect are attained to such a degree as to warrant their being substituted for others, the results of which are known from long experience.

The quality of coal gas varies considerably during the period of distillation, the first products usually containing carbonic acid, olefiant, and sulphureted hydrogen gases; while those obtained towards the end of the process contain hydrogen gas and carbonic oxide. The quantity of gas produced in a given time varies also very considerably: such a retort, as is shown in fig. 8, will generate it at the rate of about three cubic feet *per* minute at the commencement, and continue to do so, or with little variation, for nearly two hours, when the quantity rapidly decreases till the end of the operation, which will occupy from three and a half to nearly four hours, when the retort is kept at a proper temperature.

Separation of the Gaseous and Liquid Products obtained from Coal.

Separation of the Tar, &c.

It has already been stated, that the liquid substances obtained from coal by distillation are tar, oil, and water; the latter generally holding in solution a portion of hydrosulphuret and subcarbonate of ammonia. As all of these leave the retort in a vaporous state, the condensation of this vapour is an object necessary to be attended to, and it is more or less perfectly effected by passing the same through tubes or vessels surrounded with cold water, or otherwise exposed to a cooling medium.

Refrigatories for this purpose have been variously constructed; some differing, in no respect, from the worm of a still-tub; others so arranged as to present broad, flat, or curved surfaces to the action of the cooling body;—all these, and similar contrivances, do not, however, effect the separation of the tar and oils;—a minute portion remains suspended in the gas, of which it is not easily deprived. Time and stillness, or the absence of agitation or currents, have a considerable influence in inducing a deposition; and by constructing the internal parts of the condensing apparatus very large and roomy, as regards their transverse section (but, at the same time, of forms exposing a great surface), the gas is required to travel through it with a proportionably slow current, thereby giving the tar a better opportunity of depositing, than if the vessels were of a less area of section, and greater in extent otherwise. It is therefore of little consequence of what particular forms the condensing vessels are made; a flat tube, of considerable area, placed perpendicular, or nearly horizontal (and surrounded with water), and extended in one continued line or otherwise, as circumstances will admit of, and having proper apertures for the admission and discharge of the gas, and a suitable reservoir and outlets for the tar and other fluids, will be found to answer the purpose as well as constructions of greater complexity.

Such an apparatus is represented in Plate LXXXII. fig. 1, where *a a* is a water-tight cistern; *b b*, a range of tubes placed vertical, connecting with each other as shown; *c*, entrance-pipe for the gas, and *d*, that where it makes its exit; *e*, a pipe to convey away the tar and other condensible liquids which fall down into the lower part of the vessel, *f f*.

Another construction is represented in fig. 2, where *a a* is a close cistern or vault of brick, stone, or iron, having an opening *b*, for admitting the whole of the volatile products of the distillation; another

* Accum's *Description of the Process of Manufacturing Coal Gas*, 1819, p. 44.

at *c*, for drawing off the tar and other fluids at any particular level, the pipe there attached being made to slide vertically through a stuffing box. A vertical partition is placed in the vault, extending nearly the whole of its length, to cause the gas to circulate through it previous to its passing into a third opening *d*, which conveys away the crude gas, and so much of the tar, &c. as has not got deposited in the vault *a*; *e e*, a water-tight cistern of iron or other material, through which a current of cold water is continually circulating: it may either be placed over the former, or in any other convenient situation, and the pipe *f f f f*, traverses this vessel as shown, sloping gradually upwards till its termination at *k*, where it passes forward to the purifier. The gas in its ascent along this pipe is exposed to the action of the cold surface, and the tar and oils which are thereby condensed run back into the vault *a a*.

It is not easy to assign a limit to the magnitude of this part of a coal gas apparatus; the slower the passage of the gas through it, and the larger the capacity of the tar-vault and condensing tubes, the more perfect will the separation of the tar and gas be. But, in fixing the opposite limit, it will be advisable to make these of such capacity, that each portion of the gas may he detained at least three quarters of an hour in its passage through the same.

The quantity of tar, and other liquid products, yielded by a given weight of coal, varies considerably, not only according to the quality of the coal, but from the manner in which the decomposition has been effected, and which has already been spoken of. One cwt. of good cannel coal gives, when distilled at a bright red heat, from six to seven lbs. of tar and oils, and commonly about half that weight of water, making together one ale gallon or thereabouts.

Separation of the Gases unfitted for the purposes of Illumination.

Purification of the Gas.

These, in general, consist of sulphureted hydrogen, carbonic acid, carbonic oxide, and hydrogen gases.

To separate them entirely from the carbureted hydrogen and olefiant gases forms no easy task, and in gas-light establishments attention has principally been paid to the first of these; and though the means used to detach the sulphureted hydrogen have also served to take away the carbonic acid, neither the separation of this acid gas, nor that of the other gases above enumerated, have been considered of much importance.

It has been already noticed, that the sulphureted hydrogen and carbonic acid gases are produced principally at the commencement of the distillatory process, and disappear almost entirely towards the end. From the experiments of Dr Henry,* it appears, that gas from Wigan cannel contained about 5 *per cent.* of each of the above, and other varieties of coal from different parts of the kingdom, furnished results of a similar nature; but unless care be taken to make use of coal, separated as much as possible from the common pyrites with which it frequently abounds, the quantity of sulphureted hydrogen gas will be increased very considerably, and its separation be but partially effected by the application of cream of lime, as commonly applied. Potash, and some other substances, on account of their costliness, have not been made use of, at least on any large scale; and though various plans have been proposed for absorbing the sulphureted hydrogen gas, it does not appear that any have been found to answer in which lime was not the principal agent, and used either in the shape above mentioned, or more or less combined with water.

Chlorine, from its property of uniting with sulphureted hydrogen gas, has been proposed as a fit substance for the purification of coal gas. The impossibility, however, of presenting the two gases together, in proper proportions, would be a sufficient reason for not using it, were others wanting. Chlorine, however, acts upon olefiant gas, as appears from Dr Henry's account (*Man. Mem.* Vol. III. new series), in which objections are also mentioned to another proposed plan of purification, by passing the gas through red hot iron tubes.

Washing the crude coal gas with water alone has frequently been practised, but very little benefit can result. A simple, but very ineffectual mode of purifying the gas by the action of lime cream, and which was practised for a considerable time, consists in merely forcing the gas through a tube, or tubes, terminating a few inches beneath the surface of the fluid, as represented in fig. 3; *a a*, a close vessel having pipes *b, c, d, e*, attached to it; the first of these serves to introduce the lime cream, the second to admit the gas, the third to take it away, and the remaining one to draw off the lime and water. The vessel being about half filled with the liquid, gas is forced in at the pipe *c*, and on making its escape at the lower extremity, it rises up in bubbles, exposed to the action of the lime, and is thereby somewhat purified; and when the liquid is supposed to be saturated to a certain degree, it is drawn off, and a fresh supply introduced.

Another variety of purifier is represented in fig. 4: *a a* is an oblong close vessel, having a number of vertical partitions made fast to the top and sides, but not reaching to the bottom; these are pierced near their lower edges with a number of small holes; *c*, pipe to introduce gas, and *d*, one for conveying it away; lime cream being put in by means of the vessel *b*, to the height shown, the gas is forced forward, and passes, exposed to the action of the lime, through the perforated plates one after another, and finally escapes at *d*.

In order more fully to expose the gas to the action of the lime cream, a variation from fig. 3 has been effected, and is used in some of the gas-lighting establishments in London and elsewhere. Fig. 5, *a a a a* is a flat cylindrical vessel, having tubes *c* and *d* for the entrance and exit of the gas; *b*, a bent tube communicating with the vessel *a*, and through which the lime cream is introduced; *e*, a

* *Philosophical Transactions for* 1808, and *Manchester Memoirs*, Vol. III. new series.

pipe and valve to draw off the same when requisite; *f f*, an inner cylindrical vessel, having a broad flanch or plate, *g g*, attached; *h h*, a vertical axle, working through a stuffing box, and carrying an agitator near its lower end. Lime-cream is introduced to the level shown; the gas, on being forced in, fills the interior cylinder *f f*, and escapes along the under side of the broad flanch *g g*, and is there greatly exposed to the action of the liquid, and which action is increased by the motion of the agitator. After passing the flanch *g*, the gas escapes into the upper part of the outer cylinder, and is conveyed away by the pipe *d*. In order to render the purification more effectual, two or three of these vessels are connected together, so that the gas passes through the whole of them; and by discharging the liquid from one at a time, the irregular action, which would otherwise be experienced, is in some measure done away.

In fig. 6 is shown a different construction of purifier; *a a a a*, a close vessel, and containing an internal one *b b*, open at the bottom, and furnished with a number of notches along each of its sides; the pipe *c*, which brings in the gas, communicates with the inner vessel, the discharging pipe, *d*, with the outer one. Lime-cream is admitted from a proper vessel, *e*, through the pipe *f*, until the notches, above mentioned, are covered; *g g*, an axle passing through air-tight collars at one end of the inner and outer vessels, and furnished with a handle or winch to turn it round by; this axle carries a number of short arms, or levers, corresponding to the notches of the inner vessel, each of which passes through two of them during every revolution of the axle; the use of these arms is partly to agitate the lime-cream, and partly to keep the notches clear from the incrustation of the lime. This contrivance forms a part of one of Mr Clegg's patent inventions, the other parts of which, as they relate to a complex apparatus for discharging the lime after using, are here omitted. The lime-cream may be taken off by a pipe similar to *e*, fig. 5, attached to the lower part of the vessel.

From the principle on which all these purifiers are constructed, it is obvious, that where only one is used, the process must be carried on with extreme irregularity; for if when each charge of lime-cream is first admitted, a proper degree of purification is effected, the same cannot continue with any degree of uniformity, but must gradually become less perfect till the lime is discharged; and though this defect may be in some measure remedied by using two or more purifiers, even then the action cannot be very uniform. Fig. 7 represents a purifying apparatus, which, though it obviates the want of regularity above mentioned, has been found somewhat troublesome to keep clean, from the difficulty of getting into the inside to remove the lime which adheres internally: *a a a a*, is a close vessel with pipes, communicating at *c* and *d*, to take the gas in and out; *f f*, a cistern surmounting the vessel *a*, and this is surrounded by another cistern *g g*, somewhat deeper than the former; *h h* are partitions, or shelves, placed nearly horizontal within the vessel *a*, and fitting to its internal cavity, except at one edge, as represented; lime being put into the external cistern, and water admitted by means of a cock, or pipe, the mixture overflows into the inner cistern, and, passing through the tube *b*, traverses gradually to the bottom of the machine, forming thin sheets of liquid as it descends from shelf to shelf, and through which the gas has to make its way in passing upwards. The lime-cream is thus constantly supplied from the outer cistern, and as constantly running out by the pipe *e*, after it has performed its office. The effect which such a purifier can produce, must, unless made of very large dimensions, be somewhat limited, and without a construction to which mechanical force can be effectually applied, the process will be accomplished but in an imperfect manner.

A purifier, where the lime can be regularly admitted and discharged, is mentioned in a late publication (Peckston *on Gas-Lights*, p. 408) as of very recent invention; its particular construction, however, is not manifest from the description there given.

In fig. 8 is represented the vertical section of a purifying machine, which, while it has the property of regularity of action, also admits of a very effectual application of its powers: *a a*, *b b*, is a cylindrical vessel placed in an oblique direction, and having a number of internal partitions, *h h*, standing up nearly to its axis, in which is placed a spindle, *k k*, carrying a number of arms, *l l*; these act as agitators, and also are capable of scooping up portions of the lime-cream, which is represented as contained in the different cells formed by the partitions *h h*; *a a*, *f f*, a vessel forming an addition to the upper end of the cylinder, and closed on all sides except where it joins to the cylinder, and where the exit gas pipe, *d*, and the lime admitting tube, *e*, are inserted; it is surmounted with a cistern, *g g*. Through the aperture *e*, a vertical axis descends, giving motion to the inclined one *k*, by means of two conical wheels: *m*, an inverted cup, and *n*, an agitator, both fixed upon the vertical spindle. The lower end of the cylinder is united to a vessel *p p*, closed like the upper one, except where it joins at *b b*, and having an admission pipe, *c*, for the gas, and a pipe, *q*, to take off the impure lime-cream. The cistern, *g*, is supplied with water by means of a pipe, or otherwise, and the axle being kept in motion, lime is put into the cistern, *g*, and there mixed and stirred about by means of the agitator, *n*; from this it descends into the cylindrical vessel, and is collected in the uppermost cell, from which situation it is scooped up and dashed about by means of the arms, *l*, and a part of it constantly dropping down past the uppermost partition, is then received into the next cell, and the same process is regularly going forward the whole length of the cylinder, the lime-cream finally escaping at the pipe, *q*, in an impure state. The gas, in its ascent upwards in this machine, has to pass among all the arms upon the inclined axis, and to encounter perpetual spray, and showers of the lime-cream, which are constantly renewed, the supply being regulated by the quantity of lime and water introduced into the upper cistern.

If a purifying apparatus were constructed, in which the properties of figs. 6 and 8 were combined, it would probably be found more complete than any one at present in use; the essentials being a constant

supply of lime-cream, and its proper application; and the means of making the machine, by its common action, keep itself free from obstructions by the clogging and adhering of the lime to its different parts.

The quantity of lime necessary to purify a given bulk of gas will no doubt vary considerably, according as the coal used is more or less free from admixture with impurities, affording sulphureted hydrogen gas on distillation: the weight of lime, compared with that of the coal distilled, has been stated at from 1-30th to 1-10th, but the application of tests from time to time to portions of the gas, will be necessary in order to know what proportion of the purifying mixture ought to be employed. By forcing a quantity of gas through a weak solution of acetate of lead (formed by dissolving three or four grains of it in a two ounce phial of water), the natural milkiness of the solution will assume a dark cloudy appearance if sulphureted hydrogen gas is present. Water impregnated with this gas assumes a black appearance on the addition of a drop or two of nitrate of silver. A current of gas containing sulphureted hydrogen, directed against the surface of a card or other substance which has been painted over with white lead ground up with water, will immediately discolour it.

A patent has lately been obtained for purifying coal gas by passing it through strata of recently slacked lime in a nearly dry state. With regard to the actual absorbent powers of lime, as exposed to the presence of sulphureted hydrogen gas, no accurate accounts appear to have been published; but it is not probable that the performance can equal that effected by an equal quantity of lime made into cream, and differently applied.

Reservoirs or Gasometers suitable for containing the Gas.

The Gasometer.

The simplest and best of these is the common gasometer, consisting of a cylindrical or prismatic vessel open at the bottom, and suspended over water by means of a lever or pulleys, with chain and counterbalance weights; a machine with which chemists have been familiar since the days of Lavoisier, with whom it appears to have originated, and who published a description of it in 1789.

Watt's air-holder, for containing inflammable or other airs or gases, though known to the public for upwards of twenty-five years, has now been made the subject of a patent, as applicable to the purposes of a coal gas reservoir, but for which it is not at all suited, however appropriate to the originally intended purposes of containing gases, and transporting them from one place to another.

It has been proposed to diminish the size of the vessels used for containing gas, by forcing it into them in a greatly compressed state; but unless the gas-holders for this purpose are made enormously strong, any great degree of compression cannot be attained with safety. Small portable vessels, containing gas in a compressed state, have been used for supplying light; one of these was exhibited at the Royal Institution in 1816 or 1817 (*Quarterly Journal*, No. 16); and, in 1819, Mr D. Gordon obtained a patent for a similar apparatus.

A variation from Lavoisier's gasometer has lately been used in some gas-light works, in which the pulleys and counterbalance are omitted, and the inverted vessel kept in a vertical position by guides which allow of its rising or falling, as the gas is forced in or suffered to escape. This is a very imperfect machine, as subjecting the gas to a varying pressure, and which has, therefore, to be regulated, as will be shown hereafter. Other constructions have been proposed and employed, also subject to the irregularity just mentioned.

In all cases where a steady light is required, it is of importance that the supply of gas be uniform, and therefore requisite that the pressure or force with which it is expelled the gasometer, should be always precisely the same. A gasometer on the construction first above mentioned is represented in Plate LXXXIII. fig. 1, where *a a* is the vessel for containing the gas, inverted over a cistern of water *b b*; and suspended from the pulleys *c c*, by means of the chain *d*, and counterpoise *e*; *f f* are tubes for bringing in and conveying away the gas.

The gasometer, like any other body, immersed in water, of course loses a portion of its weight equal to that of the water which it displaces; and it has therefore the less power to expel its gaseous contents the deeper it is immersed. To remedy this irregularity, additional weights are added from time to time to the gasometer as it descends, and removed again as it rises; but this method, though at present in practice in some places, is very imperfect and troublesome.

By making the chain *d* of a proper weight, it may be made to answer the purpose of a regulator of the pressure. Let it be supposed, for example, that the gasometer weighs 1000 lbs. and loses 100 lbs. of that weight when immersed in the water; and that a portion of the chain, equal in length to the height which the gasometer rises, shall weigh 50 lbs. and the counterpoise weigh 950 lbs.

		lbs.
Then, when the gasometer is immersed, its effective weight is . . .		900
To which must be added the portion of chain now acting, as increasing the weight (of the gasometer), ...		50
The sum corresponds with the actual weight of the counterpoise, .		950
Again, let the gasometer be elevated out of the water, its actual and effective weight then is . . .		1000
To balance which is opposed the counterpoise, . .	950	
And the portion of chain now removed to the other side of the pulley on which the counterpoise is, and acting with it,	50	
The sum corresponds with the actual weight of the gasometer, . .		1000

This method, though it effects the purpose of

equalizing the action of the gasometer and counterpoise as opposed to each other, is less complete than the following: Let the counterpoise (instead of being formed as shown at *e* in the figure) be allowed to descend into the water, and consist of a long cylindrical or prismatic body as represented by the dots *g g*, having the area of its horizontal section equal to the area of a similar section of the plates, or substance of which the gasometer is formed; and let the chain *d* be of a weight equal (length for length) to a column of water of equal bulk with the counterpoise.

		lbs.
For instance, let the gasometer, as before, weigh, in air,		1000
And, in water, say,		950
The counterpoise also to weigh, in air,		1000
And, when immersed, like the gasometer,		950
And, a portion of the chain equal in length to the space through which the gasometer rises or falls, weigh		50
Then, when the gasometer is immersed in water its effective weight is	950	
To which must be added the chain now assisting it as weight,	50	
Sum, corresponding with the weight of the counterpoise,	1000	
Reversing the case, let the gasometer be out of water, it then weighs		1000
The counterpoise now immersed, its effective weight is	950	
And the chain, now assisting the same,	50	
Gives a sum of	1000,	

corresponding to the weight of the gasometer; and in every point of the ascent and descent, this opposite equality will be found to exist.

It will have occurred to the reader, that gasometers counterpoised in the ways above described, can have no power to expel their contents; but it is obvious enough that the counterpoise may be lessened in weight so as to cause any given pressure on the gasometer, but without affecting the equality of such pressure.

Were the gases made use of for illumination, of the same specific gravity with atmospheric air, the above method of adjustment would be perfect, but as the specific gravity of coal gas is considerably less than that of the air (being only about two-thirds of it at the common atmospheric pressure), a compensation for this is requisite. The gasometer, when filled with such gas, will, of course, require a less weight to counterbalance it than it otherwise would if filled with air, and the weight of the chain must be therefore lessened as will now appear.

	lbs.
Let it be supposed (in consequence of the levity of the gas) that the gasometer, when filled, weighs, in effect, only - - - -	995
Then the counterpoise must actually weigh	995

and its horizontal section must be lessened, so as to displace, of water, only 45 lbs.; and the portion of chain above mentioned must weigh only 45 lbs. It will then be found, that, as in the former case, an equilibrium subsists between the gasometer and counterpoise.

We have seen, where a sufficient depth of cistern was not obtainable, a form of gasometer, represented in fig. 2, adopted. This consists of two parts, detached from each other; the inner one, *a a*, being of itself a gasometer of the common construction, but surrounded with a channel, *b b*, containing water, and which, as it rises up, connects with the outer part, *c c*, and carries it upwards also; the two forming together one gasometer. In like manner, more outer parts might be added, but the thing is sufficiently complex, as shown; *d d* are pulleys, with weights just sufficient to counterbalance the outer part, *c c*, but not to elevate it without the assistance of the weight, *e*. Other contrivances have been proposed for saving of room on somewhat similar plans, but, like the above, they are not deserving of much attention, and only proper to be resorted to in cases of necessity.

Fig. 5 is another variety of gasometer, which appears lately to have got into use, though it is very imperfect, or rather totally deficient in the essential property of giving an uniform pressure to the gas contained within. Having no counterpoise, it requires to be elevated by the forcing in of gas under a considerable and varying pressure, and the addition of a regulator or governor (described hereafter) is necessary to equalize that pressure where the gas is emitted for the purposes of combustion. The parts, *a a*, *b b*, *f f*, are similar to those of fig. 1, but instead of the pulleys and counterpoise, the gasometer moves vertically upon the slides, *c c*. A species of counterpoise is sometimes applied to this gasometer, consisting of a vessel, *z*, open at the bottom, and attached by its top to that of the gasometer; as the gasometer sinks, the air in this vessel becomes compressed more and more, and exerts itself so as to act as a counterweight in some degree.

Fig. 7 is a revolving, or partially revolving, gasometer, described by Mr Clegg, with whom the contrivance originated: *a a a*, a cistern nearly filled with water, as shown; *b*, an axle, hollow at each end, and working on friction sectors; *d d d*, a vessel supported by arms radiating from the axle, and formed of parts of two concentric cylinders, closed at their ends, and also closed at *g*, except where the entrance and exit gas pipes, passing from *g* to the hollow axis, are connected (one of these is only shown in the figure, the other being directly behind it); the end, *h*, is open, and when the gasometer is filled with gas, it is just immersed in the water; *i*, a pulley, to which is attached a chain and weight, *k*, disposed as represented. The whole apparatus is constructed so as to be in equilibrium in any position, the framing being made heavy at that part of the circle to which the gas-holder does not extend, so as to counterbalance the matter opposed to it. The gas enters at one of the hollow ends of the axis, and passes through one of the tubes *g*, into the gasometer; and it is discharged, under any required pressure (obtained by means of the weight *k*), through the other tube behind *g*, into the farther extremity of the axis. This form of gasometer is somewhat

Gas-Lights.

expensive; but, from the circumstance of its requiring a shallow water cistern, may be resorted to in some cases with propriety.

The vertical section of another of Mr Clegg's devices, and which he calls a Collapsing Gasometer, is shown in fig. 8. The sides close together like the two boards of a book, and the formation and action of the ends cannot be better described than by a reference to the opening and closing of the folding divisions or pockets of a pocket-book. The difficulty of making such a length of joint gas-tight will be found no small objection to the use of this gasometer; and the single advantage it appears to possess is the shallowness, and consequent cheapness of the cistern *a a*, in which it is placed. The balance weights *b*, *b*, act upon the bent levers *c*, *d*; *c*, *d*; which cross each other, and are attached to the sides of the vessel, and with the pressure of the gas cause the same to expand or collapse as required; imitating (in effect) the rising and falling of the common gasometer. This construction scarcely admits of an uniform pressure being given to the gas when expelled, and that must, therefore, be accomplished by means of a regulator attached to it.

Gasometers are usually made of sheet iron of from two to three lbs. to the square foot, with internal frame of wood, cast or bar iron. When constructed to rise and fall vertically, as in figs. 1, 2, 5, a cylindrical form is to be preferred, as the water pits, or cisterns over which they are suspended, are more easily constructed of that shape, than of square, oblong, &c.

Various methods of suspending gasometers have been adopted, the principal end in view being, as above stated, to equalize the pressure as much as possible; and, in the furtherance of this object, it is desirable to make the working parts of the machinery on a construction the least liable to the effects of friction. The pivots, or axes of the suspending pulleys, are usually placed on friction rollers or sectors, such as are represented in figs. 3, 4, 7; the first of which we consider as the most perfect, having seen it applied to gasometers of great magnitude with all desirable success; there being no other friction than that occasioned by the steel edges *a a*, which carry the whole, and work upon bolsters of the same substance: *b b* are two sectors, having the curved parts on which the pivots of the pulley *c* roll, concentric to the edges *a a*. The application of two sets of these to a gasometer is shown in Plate LXXXIV., where the counterweight is represented as working within a central tube, thereby making the arrangement very compact. In this plate are also shown weights to preserve the sectors in equilibrium, and counteract the effect which would otherwise be produced when they are moved from a vertical position.

Fig. 4, Plate LXXXIII., represents the axis of the pulley *c*, working upon friction rollers (*a a*, with their support *b*) of the common construction. In fig. 7, the axis of the gasometer works upon a sector somewhat similar to fig. 3 reversed; but this form renders it necessary that the axis shall be kept in its proper situation by means of a double or forked frame as shown, and thereby causing a certain degree of friction from which fig. 3 is exempt.

The manner of conveying the gas into and out of the gasometer, delineated in figs. 1, 2, 5, is the simplest and best when it can conveniently be practised. It, however, sometimes happens that access to the lower part of the pit or cistern is difficult to be obtained, and other means have to be resorted to. Swivel or flexible jointed tubes, arranged so as to rise and fall with the gasometer, though they answer well enough on a small scale, are with difficulty made of large capacity so as to have little friction. We have seen jointed tubes connected by means of water-lutes extensively used, and which answer well the intended purpose; one of these is represented in fig. 6, *a* being the pipe where the gas is introduced; *b* a vertical pipe capable of a small angular motion on the axis or support *c*, and connected with *a* by means of a water-lute joint; its upper end is also connected in a somewhat similar manner to one end of the pipe *d*, and again at *e*, another moveable water-joint is placed; *f* is the pipe connecting with the top of the gasometer; *g* a regulating radius bar centered to a bracket attached to the pipe *d*, and working on a fixed pivot at *i*. The gasometer rising or falling, carries *f* along with it, and in the rest of the apparatus a motion is induced, corresponding with the connection of the different parts.

Having more or less minutely described different constructions of gasometers, it may be proper to explain the nature of such contrivances as have been introduced to render uniform the pressure of the gas issuing from such as do not possess the means of regulation within themselves.

The Governor.

Fig. 17. Plate LXXXI. represents one of these governors, consisting of a crooked tube *a a a a*, with a conical valve seat fixed in it at *b*; *c*, a valve fitting the seat when shut, and having a stem carried upwards and connected with the inverted conical vessel *d d*; *e e*, an exterior vessel, in which water is contained to the level represented. The gas enters at the bottom tube, and passing through the valve, escapes at the other horizontal extremity of *a*, and at the same time fills the upper part of the inverted vessel *d d*, and raises it more or less according to the pressure and velocity with which the gas enters; thereby partially closing the valve as the pressure increases or diminishes, and thus regulating the quantity of gas discharged through the machine.

Fig. 18 is another regulator or governor, not differing in principle from the former; the gas enters at *a*; *b* is the valve seat; *c* the valve with stem connected to the inverted vessel *d*, which is suspended in a cistern of water *f f*, and moves upon a pivot at *e*. The action of this apparatus is similar to that of the former one, and of the two, it is of a construction more likely to answer the intended purpose.

Distribution of Gas.

Regarding the distribution of gas for the purposes of supplying light in distant and different situations, a few remarks may be made.

The pipes or tubes for this purpose are best when made of cast iron with socket joints, and put together with lead; and for smaller sizes than what

Gas-Lights. are manufactured of cast-iron, welded or brazed plate iron connected by screws, may be used. Copper tubes are objectionable, on account of the action of the gas upon that metal if not perfectly purified; those of block-tin, lead, and some mixed metals, answer well enough when made sufficiently strong to resist external injury.

As the gas always carries along with it a quantity of aqueous or other vapour, it is requisite to lay the pipes so, that this, when condensed, can be collected and drawn off from time to time. A small declivity is, therefore, to be made towards one or more points, where cocks, closed vessels, or inverted siphons, are to be placed, to collect and take off the water, &c. accumulating. For stopping off the gas in large pipes, waterlute valves are generally used, one of which is represented in fig. 16, wherein *a* is the valve, formed like an inverted cup, with rod (working through a stuffing box) attached, and handle above; *b*, an annular cavity containing water, into which the valve, when shut, falls. This is about the simplest, and probably the best form of valve, and though others of a more complex nature have been used, they do not appear better adapted for the required purposes.

It has been usual, in practice, to allow half a cubic foot of coal gas *per* hour for the supply of a light equal to that of a mould candle of six to the pound, and of which one pound will, when the candles are burnt singly, last 40 hours. If the gas, however, is properly prepared, and burnt under favourable circumstances, it does not, in point of fact, require above one-third of a cubic foot to produce such light, as will be hereafter shown. But, taking the common allowance, the sizes of pipes necessary for transmitting gas to supply various quantities of light, under the pressure of a column of water, of from five-eighths to three-fourths of an inch, and making very ample allowance for friction, may be stated as follows:

Diameter of Pipes in Inches.	Number of Candles' Light to be supplied.
$\frac{1}{2}$	20
1	100
$1\frac{1}{2}$	240
2	450
3	1,000
4	2,000
5	3,400
6	5,000
8	9,000
10	14,000

It frequently happens, where gas-lights are used, that the times and periods of burning them are very irregular; thereby rendering the quantity of gas consumed a matter of uncertainty, subjecting both the manufacturer of the article and the consumer to the liability of not being fairly dealt with by one another. To remedy this evil, and generally to ascertain the quantity of gas manufactured, different modes of measuring it have been proposed. Gasometers, suited in size for each consumer, and filled from time to time with gas from proper feeding pipes, though they would answer the intended purpose, are objectionable on the score of expence, and the room they would occupy, and the trouble, which would be considerable, of attending them; and though it is by no means impracticable to construct such, with a self-acting apparatus attached, for filling it, and registering the quantity of gas admitted, yet the cost would, in most cases, more than counterbalance all advantage to be derived from it.

Gas Meter. A self-registering gas meter, of a cheap, efficient, and generally applicable construction, would be an object of considerable importance to manufacturers of gas. In the *Repertory of Arts* for February 1817 is described an exceeding complex apparatus for this purpose; which, as it has been abandoned in practice by Mr Clegg, the patentee, need not be explained here. A much simpler and better machine for this purpose is described in a late work (Peckston *on Gas-Lighting*), and of which sections are given in Plate LXXXII. fig. 12, where *c c* represents the outside casing, in form of a flat cylindrical drum, having a bent tube, *a*, inserted at its centre, for admitting the gas, and a branch, *b*, for conveying it away; *g g*, are two pivots, one supported from the tube *a*, and the other from an external water-tight cup, projecting from the outside casing, and in which is contained a toothed wheel, *h*, fixed upon the pivot, and connected with a train of wheel-work (not shown in the figure), to register its revolutions. The pivots are fixed to and support a cylindrical drum-shaped vessel, *d d d*, having openings, *e e e e*; internal partitions, *ef, ef, ef, ef*; and centre piece *f f f f*; all of which will be understood best by inspection of the figure. The machine is filled with water (poured in at *h*) up to the level of *i*; and gas being admitted under a small pressure at *a*, it enters into the upper part of the centre piece, and forces its way through such of the openings, *f*, as are from time to time above the surface of the water; and, by its action upon the partition nearest in contact with the water (to the right hand of that figure in which all the partitions and openings are shown), a rotatory motion is produced; the gas from the opposite chamber being at the same time expelled by one of the openings, *e*, and escaping at *b*, as before-mentioned.

The quantity of gas discharged by this machine in any given time, depends not only upon its internal dimensions, and number of revolutions made, but also upon the level of the surface of the water within it; and, as such discharge of gas will be greater or less, as the quantity of water is less or more, attention to its being kept at a proper level is of the first consequence to the due action of the meter; and for this reason, means must be employed to insure a supply of water, and a suitable outlet provided, to prevent its accumulating in an undue quantity.

Burners. For the combustion of gas, burners, of many different descriptions, have been used, and the gas made to issue through apertures of almost every variety. Experience, however, has proved, that small circular holes, of from one-fortieth to one-sixtieth of an inch diameter, are most advantageous; and these

are disposed in various figures, so as to form lights of one or more jets, and in circles to resemble the burners of the argand lamp.

Particular attention should be paid to construct burners so as to allow the atmospheric air to come freely in contact with the flame; and, for this purpose, when a single jet or light is wanted, the perforation may be made at the point of a small cone, as at *a*, fig. 9; and, for additional lights, other apertures, *b b*, are added near its base; such, having three flames or jets, as represented, have been named cockspur lights. Fig. 10 is a bat-wing burner, where the flame issues from a narrow slit cut across its top.

When lights are required equal in intensity to four or more candles, the arrangement of the holes in a circle, with a central opening to admit atmospheric air, and with exterior cylindrical glass, as in the argand lamp, is to be preferred; and burners giving the light of 10, 15, 20, or a greater number of candles, may be advantageously used on this construction, varying the diameter of the luminous ring according to the number of apertures required. Fig. 11 is a full-sized representation of a burner with 12 holes, *c c*, having an air tube, *d*, in the centre of half-inch diameter; *a*, the branch through which the gas is admitted into the cylindrical cavity, *b b*, in which it circulates during its passage to the orifices *c c*; this burner may, with propriety, be used to give the light of six or eight candles. Much smaller ones, where the air-tube, *d*, is less than about three-eighths of an inch, do not answer well; as the atmospheric air is apt not to circulate through them, and the flame unites, in consequence, into one smoky mass.

Count Rumford (Essay XVI.) details a number of experiments on the comparative economy of different sized flames, produced from various burners applied to an argand oil lamp, and from which it appears that there is a certain varying proportion betwixt the diameter of each burner, the intensity of the light, and the quantity of oil consumed; the consumption of oil being greatest in proportion to the light obtained when the flame was small, and gradually lessened as the light was enlarged, until it began to smoke, when the proportional consumption of oil again increased. With an argand burner of about $\frac{7}{10}$ths inch diameter at the middle of the flame, he tried the proportional consumption of oil when the light was regulated, so as to be equal to that of a successive number of candles, of from 1 to 10; the result, in grains of oil, which gave an equal and corresponding quantity of light for one hour, are given in the following table, and the quantity necessary to supply the light of one candle in each case is also added.

Candles (wax, 5 of which are equal to 4 of those mentioned in another part of this article).	Grains of Oil *per* hour consumed, to give light equal to the corresponding number of Candles.	Grains of Oil equal to one Candle.
1	246	246.0
2	300	150.0
3	329	109.6
4	390	97.5
5	437	87.4
6	476	79.3
7	507	72.5
8	556	69.5
9	603	67.0
10	722	72.2

From this table it appears, that the lamp here used burned to the greatest advantage when made to give a light equal to eight or nine of the wax candles; and from other experiments of the like nature, the proportions above hinted at may be taken as follows:

An oil argand burner one-third inch diameter, is most advantageously employed when giving a light equal to about . . . . . 3 wax candles.
One 11-20th inch diameter, about 5 Do.
One 7-10th (being that above particularized), about . . . . 9 Do.

It was to be expected that something similar to the above would occur with regard to the combustion of gas, and this we have seen fully established by experiments made in 1807 and later years, and without any knowledge of what Count Rumford had done.

An argand gas burner, about three-fourths of an inch diameter, when regulated so as to give light equal to one mould candle of six to the pound, consumed

	Cubic feet of Gas,		Cubic feet per Candle,
per hour	1.43	being	1.43
when equal to 4 candles,	1.96		0.49
6 do.	2.40		0.40
8 do.	2.95		0.37
10 do.	3.10		0.31

In other experiments the consumption did not exceed one-fourth of a cubic foot *per* hour for each candle, when the flames were as large as the burners would admit of without producing smoke.

General Arrangement of a Gas Apparatus.

General arrangement of Apparatus.

As the general plan of gas-lighting establishments will be affected by local circumstances which cannot here be considered, the disposition and arrangement of the different parts is a subject on which much cannot be said. Plate LXXXIV. exhibits a plan and elevation which, where the situation will admit, will be found as convenient as any. The retorts, *b b*, are placed round a conical chimney, *a a*, into which all their flues enter, and in its lower part the ashes and cin-

ders are collected from the different fires, and taken out from time to time by an entrance from the circular tunnel, *f f*. This tunnel is furnished with apertures above, corresponding to the number of the retorts, and through which the coke is suffered to descend when discharged. The retorts are covered with a conical roof, under which are a number of small openings to take off any dust, smoke, &c. which arises; exterior to this roof (which covers the part *c*, where the retorts are charged and discharged) is another over *e*, less elevated, leaving a circular space *d*, to admit light; under this may be deposited coals, &c.

The gas and other products of distillation are conveyed, by means of the pipe *g*, into the tar reservoir *p p*; over which the condenser *h*, and purifier *i i*, are placed, and from this last the gas passes by the pipe *k*, to the gasometers *m m*, through the tubes *l l* (in the manner represented in Plate LXXXIII. fig. 6), and from these again at *n*, for distribution and combustion when required.

The apparatus here delineated (on a scale of 20 feet to the inch) contains twenty-one retorts of the dimensions shown in Plate LXXXII. fig. 8; two gasometers are represented together capable of containing 50,000 cubic feet of gas; and in case of repairs, &c. being wanted, it will, in general, be found more convenient to have, instead of one gasometer of the full capacity required, two or more of a lesser size connected with the apparatus; and it may frequently happen that these can be placed at a distance from each other, particularly in lighting a town of any considerable magnitude, where such distribution will be attended with the advantages of more perfectly equalizing the pressure on the gas, and of lessening materially the size of the mains necessary for conveyance, as these distant gasometers can be filled during the period when light is not required, and the feeding mains answer the purpose of conveying the gas partly back again for combustion.

Preparation of Oil-Gas.

Oil-Gas. In Nicholson's *Journal* for 1805, Dr Henry has given an account of his experiments on the gases obtained by the destructive distillation of oil and other substances; but no apparatus for conveniently effecting the decomposition of oil on a large scale appears to have been constructed for many years afterwards. In 1815 Mr John Taylor obtained a patent for a mode of producing gas from bones and other animal matters; and the principle of action of the oil-gas machines, now manufactured by him, will be understood from fig. 9, Plate LXXXIII.: *a a a* is a metallic or other tube placed in a furnace capable keeping it red hot; *b*, the fire place; *c*, a small close box or cistern containing oil; *e*, a pipe leading from this box to one end of the tube *a*, and having a regulating cock thereon; *f*, another pipe joining the opposite end of the fire-tube, and also joining the oil-cistern at its upper side; *g*, a pipe to convey away the gas when formed, and *d*, another pipe with funnel attached for admitting a supply of oil from time to time.

The fire-tube being heated to a moderate red heat, oil is admitted by means of the cock, *e*, and in its passage through the heated tube is decomposed, or partially so, and makes its escape by the pipe, *f*, back again into the oil-cistern in a gaseous, or vaporous state, where such particles of the oil, as have merely been volatilized, are again condensed, and the permanent gas passes forward through the pipe, *g*, to a gasometer, or otherwise as required.

To render this apparatus more complete and convenient, the ingenious patentee has arranged it, for general use, nearly in the manner and form represented in figs. 10, 11, 12, which are different views of the same thing; the fire-tube here is bent in the shape of the letter U, as shown at *a a a a*; *b*, the grate; the oil is admitted at one extremity by the pipe, *e e* (having a regulating cock upon it), from the oil cistern, *c*, and the gas taken off from the other by the pipe, *f f*, as in fig. 9, above described.

The vessel, *c*, has a funnel, *d*, attached to it for the purpose of supplying oil when required. The pipe, *f*, which conveys away the gas (and any vapour which may be formed from the admission of a greater quantity of oil than can be decomposed in its passage through the fire-tube), is connected to a close vessel, *h*, which is surrounded with water contained in a cistern, *i i*; and this cistern also contains a spiral-tube, or worm, *k k*, the lower end of it connecting with the vessel, *h*, and its upper end with a descending pipe, *l*. The vessel, *h*, and worm, *k*, being immersed in cold water, serve for the purpose of condensing any oil that may arise in a merely volatilized state; and this oil being collected in the bottom of the vessel, is allowed to descend again into the cistern, *c*, by a tube connected therewith.

The gas, though now separated from the vapour in a great degree, is, in order to render it more perfectly pure, conveyed by the pipe, *l*, above mentioned, into an air-tight chest, *m m*, in which water is contained up to the level represented; *n* is an inclined partition fixed across the chest, having diagonal ribs attached to its under side, so that when gas is forced in beneath it through the pipe, *l*, it circulates underneath the partition in a zig-zag direction, gradually ascending till it escapes at the upper end, and rising through the water, is taken off at *g*, to a gasometer (such as has been already described) for use.

In order to increase the effect of the fire-tubes, they are loosely filled with different substances, the better to cause the decomposition of the oil. Pieces of brick, or coke, answer this purpose; and as these require to be taken out and renewed from time to time, there are, at *q q*, two openings, with air-tight covers, for allowing this to be effected, and by means of which the tubes can also be cleaned by scraping out such carbonaceous matter as adheres to their inner parts: *p p p* are stoppers, also for the purpose of allowing the pipes, *e* and *f*, to be cleaned in the like manner. Such an apparatus as is here represented (to a scale of one-third of an inch to the foot) will yield 100 to 120 cubic feet of gas *per* hour.

Gas-Lights.

Illuminating Powers of Coal and Oil-Gases.

Comparative illuminating powers of Coal and Oil-Gases.

To compare the expence of oil-gas with that obtained from coal, a knowledge of the comparative illuminating powers of equal bulks is necessary. It is stated (*Quarterly Journal of Science*, &c. No. XIV.), that one cubic foot of oil-gas will yield as much light as four of coal-gas; but, in another part of the same article, that the proportion is only five to nine. Mr Brande (*Annals of Philosophy*, December 1819) gives one to two as the proportional value of the two gases : our own experiments give seven to thirteen. Much discrepancy may arise from the way in which such experiments are conducted : an argand burner, which will, when burning coal-gas, give, with the greatest advantage, a light equal to any number of candles, should, when used with oil-gas, be adjusted to emit a considerably greater quantity of light, in order to burn that gas in the most economical manner. There is always a portion of blue or dark coloured flame adjoining the burner; and to make the comparison fair, this ought to bear an equal proportion to the white flame in both cases; and though some attention was paid to this circumstance in making our experiments, we have little difficulty in believing that the result would have been somewhat more favourable to the oil-gas, had the proportions of white and blue flame been more accurately adhered to; and we therefore incline to consider Mr Brande's numbers of one to two as the most correct.

The volume of gas which a given quantity of whale-oil yields has been variously stated, at from 80 to 110 cubic feet *per* gallon, and the quality of the oil, and mode of distillation, may partly account for the difference. We have not been able to obtain more than 95 to 98; but as some waste took place, in the portion which was volatilized not being wholly condensed and collected, it is probable that 100 may be taken as the number of cubic feet which one wine gallon of good whale-oil will produce.

Gas from Coal Tar.

Gas from Coal Tar.

Attempts have been made to decompose coal tar in order to obtain the gaseous products; and this may be effected without much difficulty, by an apparatus nearly similar to that used for decomposing oil, and by other means. But it does not appear from the experiments which have been made, that the gas produced is well fitted for the purposes of illumination; probably from a great quantity of pure hydrogen being mixed with the carbureted hydrogen gas formed; or, if Mr Brande's theory of the non existence of the latter gas be correct (*Annals of Philosophy*, December 1819), because the olefiant gas occurs in extremely minute quantities, compared with the quantity generated during the distillation of coal.

Explosions and Accidents.

When atmospheric air is mixed with about one-eighth part of its bulk of coal gas, and set on fire, it explodes; and, if in a confined situation, may do serious mischief. Accidents have occurred from these explosions, which originate in ignorance, mischief, or carelessness. The offensive odour emitted both by oil and coal gases unburnt, is a very sufficient warning of their escape; and the propriety of having every part of a gas apparatus perfectly tight, and free from leaks, is a matter of importance, not only as regarding safety and the prevention of this nuisance, but also the actual waste and loss of a valuable commodity. A leak from a hole one-twentieth of an inch diameter would, under the usual pressure, in the course of one year, waste coal gas to the value of L. 10 and upwards; and, supposing it to be emitting gas into a chamber of ten feet cube, it would require from two to three days to render the air of it explosive, and this only on the supposition that the apartment was nearly air-tight. Any ordinary escape of gas into a room, having a door, window, and fire-place, where a circulation of air is constantly going on, could never cause an explosion, though explosions have occurred, from its getting, in the first instance, into confined adjoining places, as closets, cup-boards, arched vaults, or the like. In these situations, when the smell of gas is perceived, ventilation should be resorted to, by opening the doors, &c. and lights should be kept away from them, until the smell ceases to be offensive.

Economy of Gas-Lights.

Economy of Gas-Lights.

We now come to treat of the expence of light obtained from coal and oil gases, and their comparative cost, compared with that from oil and tallow, as commonly consumed in lamps and candles. The fluctuations of price to which these commodities are liable, and the varying expence in different places of buildings, and other things required in forming a gas-work, must, of course, render any statement of comparison that can be given inapplicable to the forming of any other than a very general result.

The expence of such an apparatus, as is represented in Plate LXXXIV. may be taken as follows:

Twenty-one retorts, with all their appendages, tar-vault, condensing and purifying apparatus, and buildings, belonging to the same,	L. 5,500
Two gasometers, with their cisterns, and all apparatus, and buildings, - -	5,200
The cost of the main pipes, with their stop-valves, water-receivers, &c. for distributing the gas, must depend entirely upon circumstances which cannot be considered here. In lighting towns, the amount has, in some cases, equalled, or somewhat exceeded that of the rest of the apparatus. Say then, - -	10,300
Total expence, -	L. 21,000

This apparatus will be capable of supplying about 50,000 cubic feet of gas daily, using sixteen or seventeen of the retorts; the remainder being kept as a reserve in case of accidents to the others from cracks, burning, or wearing out. And though such a consumption of gas should be necessary in the depth of winter, yet it will be found, that, upon an average for the year, a daily supply of about half the quantity will suffice in the way in which it is

generally consumed in lighting towns. This apparatus may, therefore, be considered as capable of giving 25,000 cubic feet of gas each day in the year.

To procure this quantity, 48 cwt. of cannel or coal fitted for the purpose will be required, and which, in the coal districts, may be calculated at 20s. *per* ton, giving for the annual charge *about*	L. 880
Common coal for fuel, say half the weight of the above, and at half the price, -	220
Lime and water for purifying the gas, -	270
Management, wages, and sundry charges,	1,090
Annual renewal of sixteen or seventeen retorts, - - -	230
Two and a half *per cent.* on the amount of main pipes, &c. - -	260
Ten *per cent.* on the amount of the other parts of the apparatus to cover repairs and ordinary wear and tear, -	1,070
Annual expenditure,	L. 4,020

Which amounts to L. 11 *per* day as the cost of 25,000 cubic feet of gas, or about 8s. 10d. for the cost of each 1000 cubic feet, exclusive of interest on capital; with that added, it will amount to 11s. 2d., and as 20 cubic feet of gas will give the same light that 1 lb. of tallow does, the cost of it will be

$$\left(\frac{11s.\ 2d. \times 20}{1000}\right) = 2\tfrac{3}{4}d.\ \text{barely.}$$

An apparatus capable of supplying an equal quantity of light by means of *oil gas*, would in point of expence amount to nearly as follows:

Retorts with all their apparatus, condensing and washing vessels, and buildings for the same, . . .	L. 3,700
Gasometers, &c. of half the capacity of the former, . . .	3,500
Main pipes, &c. the length supposed the same as before, but the capacity reduced one half, . .	7,700
Total,	L. 14,900

The quantity of gas daily consumed will average 12,500 cubic feet, or half the bulk which could be required of coal gas.

To produce this, 125 gallons of oil are necessary, and valuing the same at L. 32 *per* tun, the annual charge will be *about*	L. 5,780
Common coal for fuel, and water, -	220
Management, wages, and sundry charges,	820
Annual renewal of retorts, . .	100
$2\frac{1}{2}$ *per cent.* on main pipes, &c. . .	190
10 *per cent.* on the other parts, .	720
Annual expenditure,	L. 7,830

Or about $4\frac{1}{8}$d. for a light equal to what 1 lb. of tallow would give; and if interest on capital is included, it will amount to about $4\frac{1}{2}$d. being, compared with the cost of coal gas-light, nearly as ten to six.

In the above calculation for the expence of coal gas, no mention is made of the coke, tar, oils, and ammonia produced. The value of the coke depends much upon the nature of the coal employed; that obtained from such as the Newcastle coal answers well for house fires, drying kilns, stoves, &c.; but the Cannel coal, which is used for making gas to a great extent in many parts of the kingdom, gives a very inferior coke, of frequently not more than 1-5th to 1-6th the value of the coal which produced it. The tar, when boiled and mixed with drying oil and other substances, forms a paint which may be used for common purposes; it may also be converted into pitch, and by burning it in close vessels, a species of lamp-black is produced. On the whole, this and the other liquid products have, however, not been considered as of much value, and the getting rid of them and of the refuse lime, which has been used in purifying the gas, is often attended with an expence which their own value, and that of the charcoal, will not more than compensate.

Though the expence of lighting by gas from oil appears, on a large scale, not to be much less than double that of coal gas, the same great disproportion will not altogether hold for very limited quantities of light, where the charge for an attendant forms a considerable part of the current expenditure. A coal gas apparatus, however small, will, when in work, require the almost constant attendance of a person to manage the fire, to charge and discharge the retort, to renew the lime or other substance used for purification, and to remove that which has done its office, also to empty the tar reservoir, &c. In the other apparatus, when the oil reservoir is filled and once set to work, it requires no other attendance for a number of hours, than the keeping of the fire in order; and the production of gas can be continued at pleasure, or stopped by the mere turning of a cock, and the nuisances accompanying the formation and removal of tar, ammoniacal liquor, and lime refuse, are entirely avoided.

An argand oil lamp with a burner three-fourths of an inch diameter, we have found to consume 406 grains of the best spermaceti oil in one hour, when giving the light of $3\frac{1}{4}$ candles of the size above specified. Five thousand grains of oil will, therefore, give the same quantity of light that 1 lb. of tallow does, and valuing it at 5s. 6d. *per* gallon, the cost will be, with an allowance for wicks and trouble of trimming, about $6\frac{1}{2}$d.

The comparative expence of light from the different substances mentioned below will then be as follows:

	s.	*d.*
Valuing the quantity which 1 lb. of tallow gives in candles at . .	1	0
An equal quantity of light from spermaceti oil consumed in an argand lamp will be	0	$6\frac{1}{2}$
A ditto ditto from whale oil gas, .	0	$4\frac{1}{2}$
A ditto ditto from coal gas, . .	0	$2\frac{3}{4}$

It would have been desirable to have been able to give a comparative table of the actual charges made for supplying gas-lights in some of the principal towns of the kingdom; but unless some stand-

ard size of the burner or burners employed was fixed, any thing of this kind would be nearly impracticable. In some places the Argand burners used are of three or four different sorts, and named No. 1, No. 2, &c. the smallest being distinguished by the least number; the reverse occurs in other places, where the highest number is used to designate the least. The number and size of the perforations vary considerably; as likewise does the length to which the flames are allowed to be burnt; and variations also take place from time to time in some towns lighted by gas, which circumstance alone would render any attempt at a comparison of the rates charged of doubtful utility. (F. F. F.)

Gas-Lights || Genovesi.

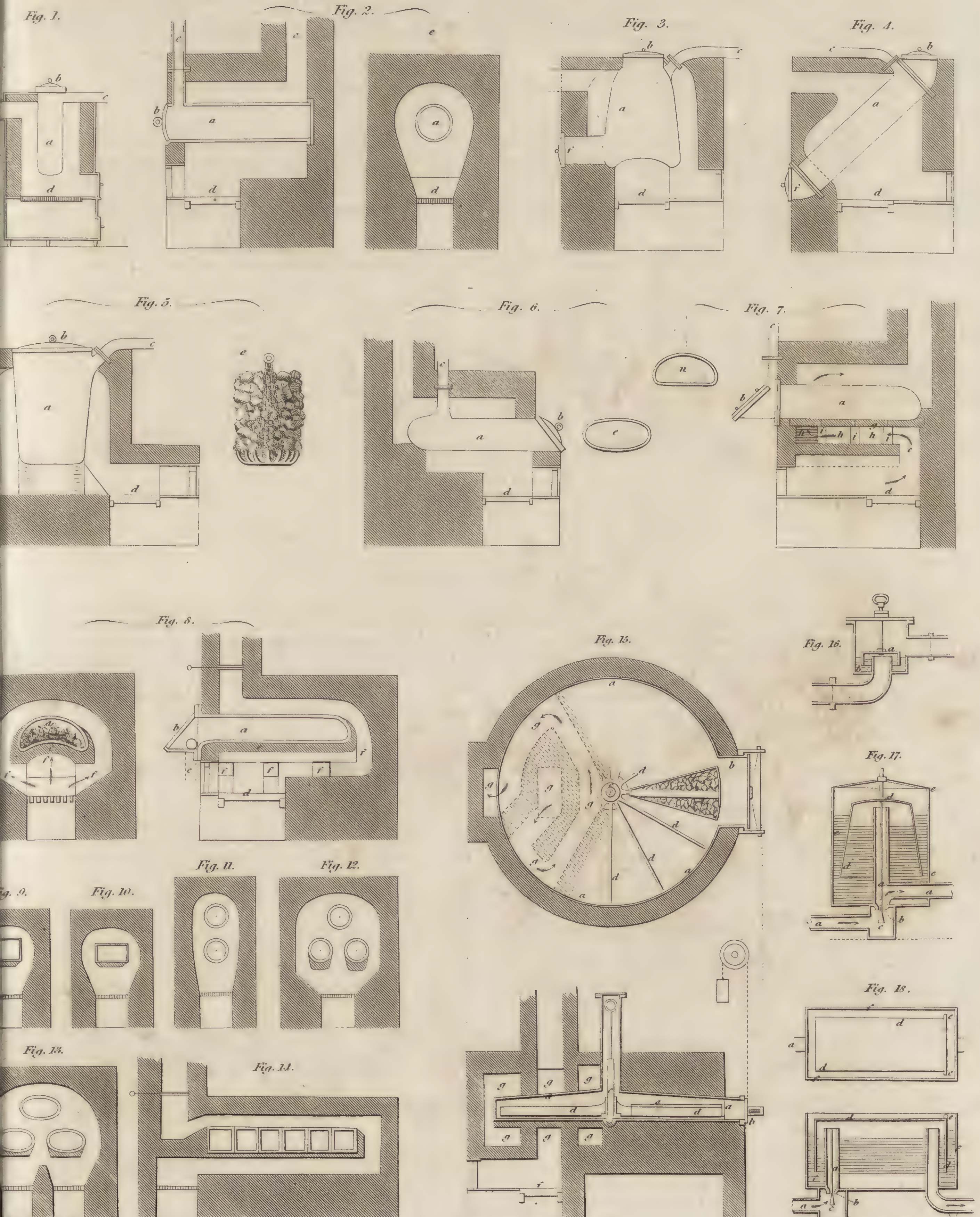
GENOVESI (Anthony), an eminent Italian Writer, was born on the 1st of November 1712, at Castiglione, near Salerno, in the kingdom of Naples. From his earliest years he showed an uncommon capacity; but after receiving such education as his native village could afford, his father obliged him to devote himself to the study of scholastic theology, with a view to the ecclesiastical profession. In a short time he distinguished himself as a proficient in dialectics; but having formed an attachment to a young woman, he was on the point of sacrificing to her all his professional prospects, when his father, who had obtained a knowledge of the circumstance, removed him to another village, where he found a priest who diverted his attention to different objects. Having been afterwards excommunicated by the Archbishop of Conza for acting a part in a comedy, he returned to Castiglione; where, having found his mistress married, he reassumed the cassock, and took priest's orders at Salerno in 1736. Here he soon distinguished himself so much by his talents and knowledge, that the Archbishop of this town confided to him the Chair of Eloquence. At this period Genovesi was a mere school theologian; but a friend of his, a young ecclesiastic, now made him aware, that there were sources of knowledge beyond the scholastic sphere, more extensive, more interesting, and more real, than those to which he had hitherto applied. Genovesi entered into this new intellectual world by the perusal of some romances; from these he proceeded to the study of history; and stepping from one subject to another, he finally applied himself to the study of modern philosophy, and read with attention the works of Leibnitz and Locke. In the hope of acquiring still farther information, he repaired to the capital; and as he did not possess the necessary means of maintaining himself there, he resolved to exercise the profession of an advocate; but becoming disgusted with the details of practice, he soon sacrificed his hopes of fortune to the pleasures of study. He improved his knowledge of the Greek, and of several of the modern languages; attended all the most celebrated professors of the University of Naples; and soon perceived the imperfections of the existing system of public instruction.

Notwithstanding the progress which philosophy had made in other countries, the kingdom of Naples was, at that period, in a state almost retrograde, or, at least, stationary. Genovesi felt this, and he resolved to accomplish certain reforms in the system of education, with a view to the amelioration of the condition of his countrymen. None ever succeeded better in this generous design. Although there existed at Naples a University, celebrated for the learning of several of its Professors, the pupils had long been accustomed to carry on their studies in private schools. Genovesi having conceived the design of opening one of these seminaries, he procured the appointment of extraordinary Professor of Metaphysics in the University, in order that he might appear before the public in a known character. He had formed peculiar methods of his own in all the faculties which constitute the philosophical course; and his first Essays induced him to publish his *Elements of Metaphysics*, of which the first volume appeared in 1743; and afterwards, in 1745, his *System of Logic*.

In these two works, he made ample use of the doctrines of Bacon, Descartes, Leibnitz, and Locke; and, having substituted philosophical doubt for implicit belief; the observation of nature for the speculations of the schools, and reason for authority,—this was sufficient to cause him to be denounced as an infidel, or at least as an irreligious person, by those who still adhered to the scholastic methods. He would probably have fallen a sacrifice to these prejudices, had he not been supported by Galiani, Archbishop of Tarentum, Grand Almoner of the King, and Grand Master of the University; but, notwithstanding this protection, he experienced some trouble and difficulty in obtaining the professorship of Moral Philosophy; and he was disappointed in an attempt to procure the chair of Theology.

The unjust and obstinate hostility which he suffered on account of his theological works diverted him, for some time, from this dangerous path of inquiry, and brought him back to that of philosophy. He published a continuation of his *Elements of Metaphysics*, but, with every new volume he continued to experience the censures and opposition of the partizans of the scholastic routine. Among these were the Cardinal Spinelli, Archbishop of Naples, and an Abbé Magli, whom Genovesi covered with ridicule in his work entitled *Lettere a un Amico Provinciale*. In spite of these continual jarrings, Genovesi obtained the approbation and esteem of Pope Benedict XIV., of several Cardinals, and of most of the learned men who at that period flourished in Italy. Of this number was Intieri, a Florentine, who having spent a long time at Naples, became much attached to that country. This man, as distinguished for his philanthropical qualities, as for the extent and solidity of his acquirements, was still more estimable on account of the use which he made of his fortune. It is to him that Italy is indebted for her first Chair of Political Economy; he founded it, at his own expence, with the sanction of government, in the University of Naples, under three conditions, viz. that the lectures should be given in

GAS LIGHT. PLATE LXXXI.



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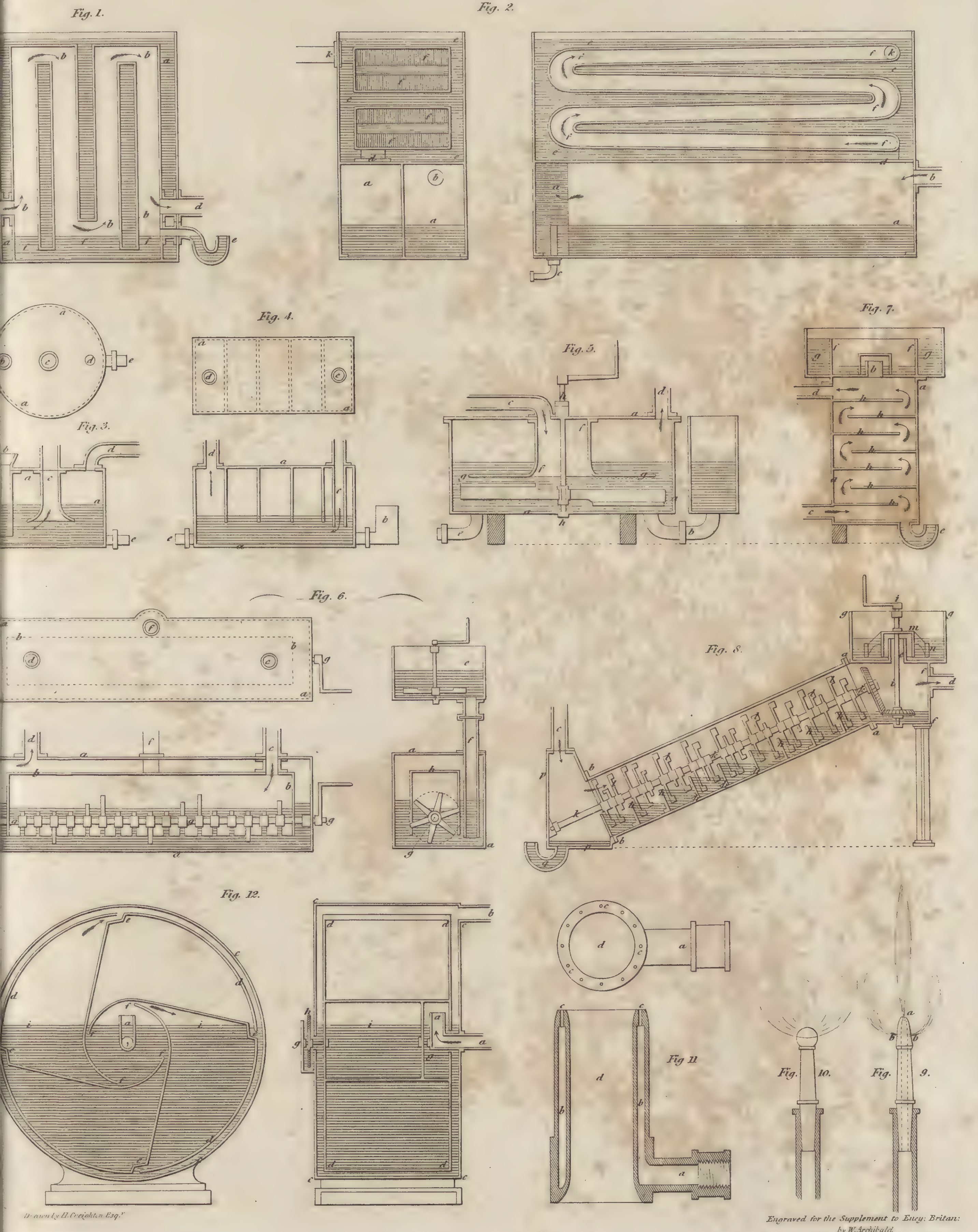

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Fig. 1.

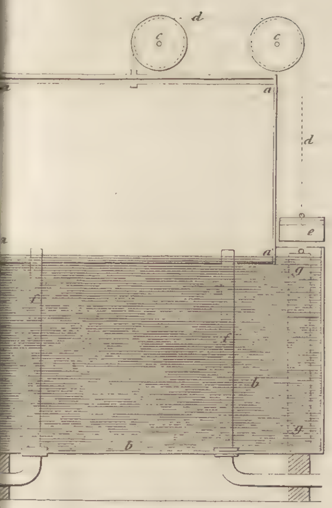


Fig. 2.

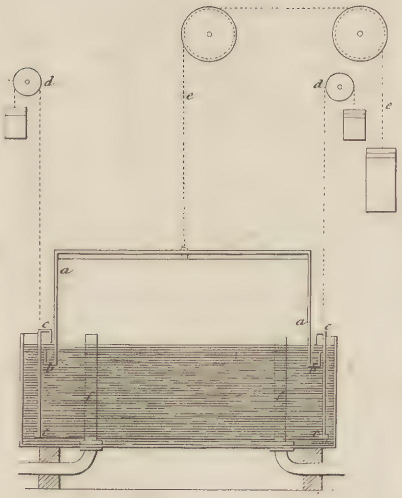


Fig. 3.

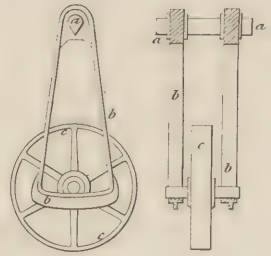


Fig. 4.

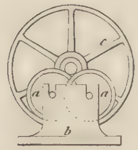


Fig. 5.

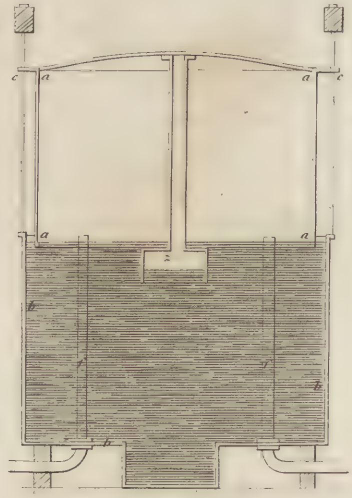


Fig. 6.

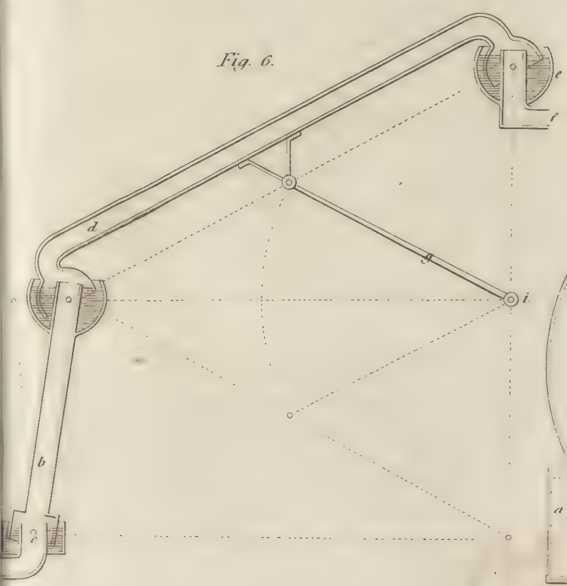


Fig. 7.

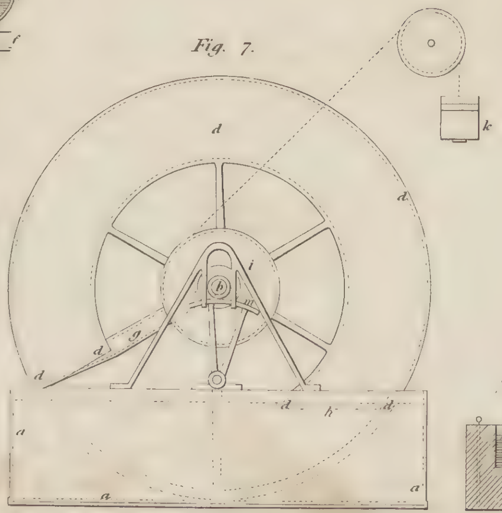


Fig. 8.

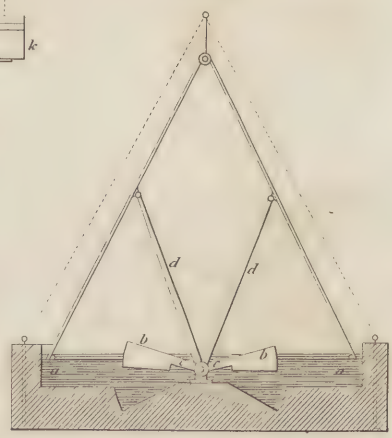


Fig. 9.

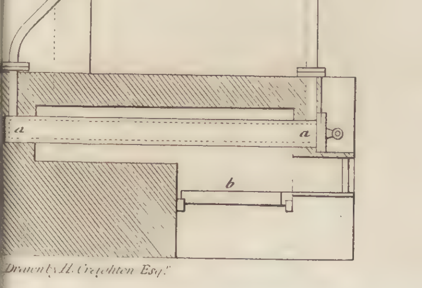


Fig. 10.

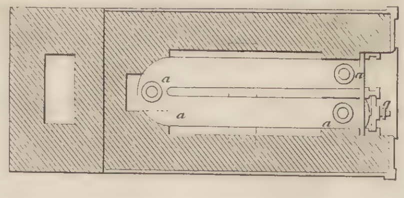


Fig. 11.

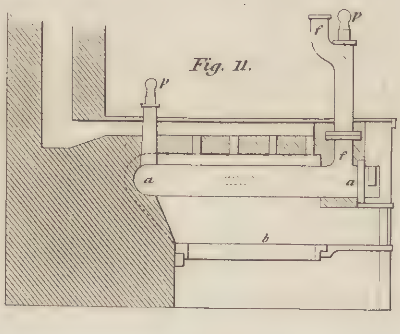
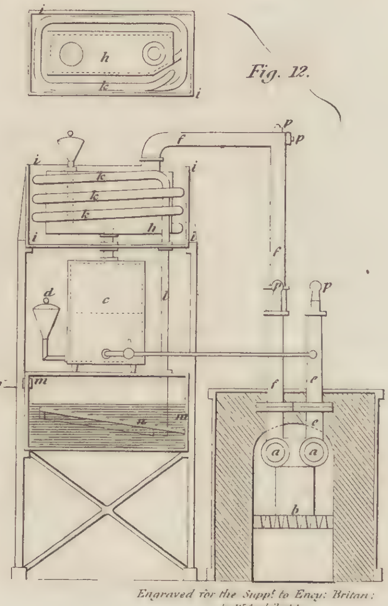


Fig. 12.



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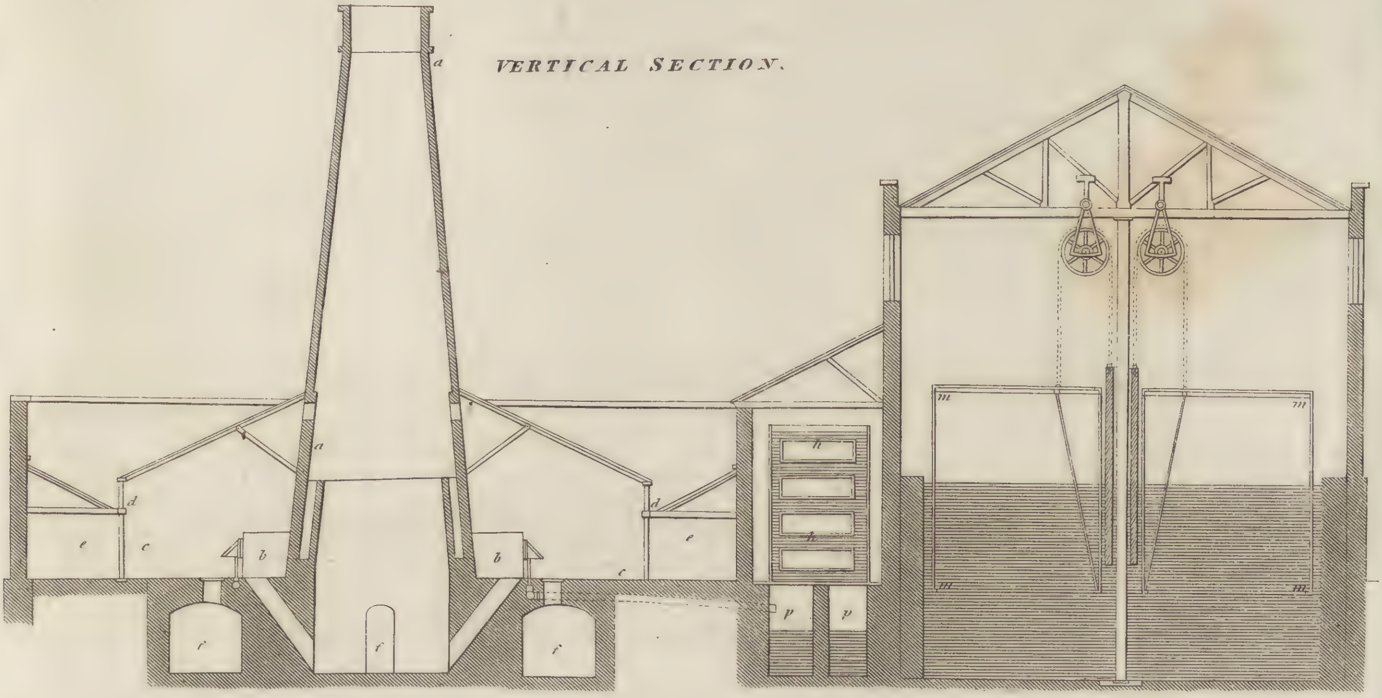
VERTICAL SECTION.



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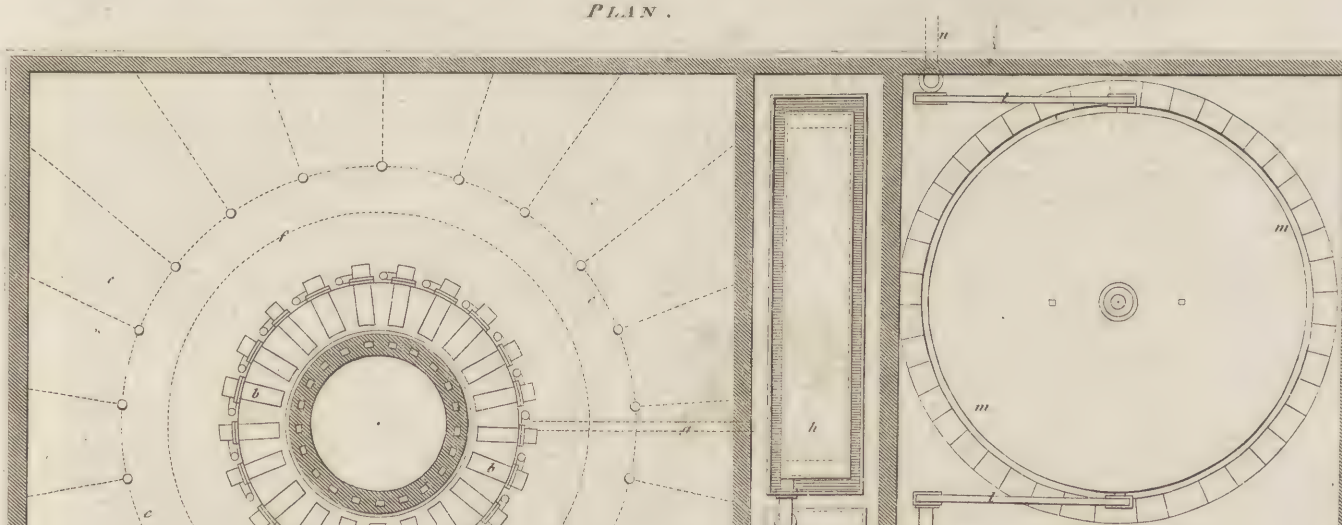

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Italian; that Genovesi should be the first professor; and that, after his death, no ecclesiastic should succeed him.

Genovesi opened his first course of lectures on the 5th of November 1754, with great success. The novelty and the interest of the subject, the eloquent style and agreeable manner of the professor, attracted a crowd of auditors, and made a deep and lively impression. Nothing was talked of but agriculture and commerce. To gratify the taste of the public for these new inquiries, he afterwards published his *Lectures on Commerce*, and Carey's *Account of the Trade of England*, translated into Italian by his brother, and enriched with Notes by himself. His *Lectures on Commerce* was indisputably the most interesting work he had hitherto published. There are some errors, indeed, in his method, and even in his doctrines; but the work contains many important truths relative to every department of public administration, and a good application of analysis to subjects which had not hitherto been sufficiently investigated. Finally, it had the merit of being the first work which introduced into Italy, and particularly into the kingdom of Naples, a taste for the study of political economy.

The great success of these lectures, which were delivered in Italian, induced Genovesi to draw up a complete code of philosophy in that language. It was at this time the custom in Italy, and particularly at Naples, to teach every thing in Latin; a practice which prevented knowledge from spreading among those classes to whom that language was not familiar; and the Neapolitans, at that period, wanted education perhaps more than any other people. He had published, in Italian, his *Meditazioni Filosofiche*, on religion and morals, and his *Lettere Accademiche*, on the utility of the arts and sciences; a treatise written in opposition to the well known work of Rousseau on that subject. Following out his plan, he began to recast all his Latin works, to improve their form, and to give them a more interesting character. The first which he published was his treatise on *Logic;* a work which went through several editions. He afterwards published his *Metaphysics*, divided into three parts; the first containing an essay on cosmology, the second on theology, and the third on anthropology. In 1767, he published part of a work on the *Science of the Rights and Duties of Man;* but this work was never completed. In all his writings, and particularly in his *Meditations* and *Letters*, the style is somewhat affected; at the same time, they present us with a good exposition of the ideas and systems of the most celebrated philosophers.

After the suppression of the order of the Jesuits, when it became a question with the government, whether they ought to be reinstated in their superintendence of public instruction, Genovesi was consulted, and his advice was, to replace the scholastic chairs, by schools of mathematics, physics, and history; and he proposed one chair for the illustration of Cicero's *Offices*.

From the commencement of the year 1763, Genovesi had felt the symptoms of a dangerous malady; but he continued to teach and to write to the last day of his life; and before his death, he had the satisfaction of witnessing the great success of his labours. Since the days of Telesius and Campanella, no School had more credit and celebrity at Naples than that of Genovesi. Pupils, some of them men of the most illustrious rank, flocked to his lectures; and those who heard him generally adopted his ideas and followed his maxims. He handled the most abstruse subjects in the most agreeable manner, and in a style almost poetical; a circumstance which gave him a great command over the attention, as well as over the judgment, of his pupils. Indeed, all that Italy has since produced in philosophical and economical science may be said to have originated in the School which he founded. He died of an attack of dropsy, on the 22d of September 1769, aged about fifty-seven.

Such is the account of Genovesi given in the *Biographie Universelle*. (Tome XVII. p. 86.) The following list of his works is taken from Fabroni: * 1. *Disciplinarum metaphysicarum Elementa mathematicum in morem adornata*, 1744—1751, 4 vols. 8vo. 2. *Elementorum artis logico-criticæ libri quinque*, Naples, 1745. 3. *Discorso sopra alcuni trattati d'Agricoltura*, Ibid. 1753. 4. *Lettere Accademiche*, Ibid. 1764. 5. *Storia del Commercio della Gran Brettagna*, &c. 1757. 6. *Delle Lezioni di Commercio*. 7. *Discorso sopra l'Agricoltura*, with a translation of Tull's *Husbandry*. 8. *Discorso sul volgarizzamento del Saggio Francese sull' Economia de' grain*, Naples, 1765. 9. *Meditazioni Filosofiche sulla religione e sulla morale*, Ibid. 1766. 10. *Della Diceosina, o sia della filosofia del giusto e dell' onesto*, 1766—1776, 3 vols. 11. *Universæ Christianæ Theologiæ elementa dogmatica, historica, critica*, a posthumous work, Venice, 1771, 2 vols. 4to.

(H.)

* Fabroni, *Vitæ Italorum doctrina excellentium qui sæculis* 17 *et* 18 *floruerunt*.

GERMANY.

Germany.

When the *Encyclopædia* was published, this great portion of Europe was involved in the confusion created by the French Revolution; its general boundaries, as well as those of each particular state, were undefined; its policy, laws, and systems of government depended on the persons who ruled in France; and neither its forces, revenues, or constitutions, could be considered as other than ephemeral.

The general peace that now prevails has at length rendered the limits of each state certain. The contingents of troops which each is to furnish, and the degree of weight each is to have in the assembly that is to unite them into one political body, depending on the amount of the population, a census has almost universally been taken, of the accuracy of which there seems no reason to doubt.

Within the limits of Germany are portions of kingdoms, parts of whose territory are not within the sphere of the confederation; thus Austria, Prussia, the Netherlands, and Denmark, have parts only of Germany within their dominions, and, therefore, will here receive such notice as is merely necessary to give a view of the whole of Germany. Austria and Denmark have already been noticed in this *Supplement*, and the kingdoms of the Netherlands and of Prussia will occur in their alphabetical order.

The four kingdoms of Bavaria, Hanover, Saxony, and Wirtemberg, are too important to be wholly included in a general article. Bavaria has been already treated of separately, and the other three will be noticed in their proper places.

Boundaries.

According to its present boundaries, Germany extends from 45° to 54° 20′ north latitude, and from 5° 43″ to 20° 50″ east longitude from London. It is bounded on the north by the German Ocean, by Denmark and the Baltic Sea; on the east, by West Prussia, Poland, Cracow, Gallicia, and Illyria; on the south, by the Adriatic Sea, Italy, and the Helvetic provinces; on the east, by France, and the kingdom of the Netherlands. Its whole extent, including rivers and lakes, is 248,832 square English miles.

Surface.

The southern part of Germany is either covered or penetrated with steep mountains, one part of which extends from the Alps and the other from the Carpathian hills. These mountains gradually lose themselves in advancing northward; and from the last of them, the Hartz, upon the confines of Hanover, begins that vast plain, which extends over the north of Germany, through Prussia, and Poland, and a considerable part of Russia. This plain was probably covered by the water long after the more southern parts had emerged from the ocean, the evidences of which are apparent in the turf moors of the sandy districts, where expensive embankments and dikes are necessary to preserve the land from inundation.

The soil is generally productive. The plains in the north have indeed much arid sandy land, but nature has provided along the borders of the rivers some rich and fruitful soils, where the most abundant harvests are gathered. The south has also on its mountains much barren or slightly productive land; but the beautiful vallies and small plains between the hills rival in fertility the best alluvial lands on the banks of the northern rivers.

Soil.

In general, the soil in the north is heavy, and in the south light, the former most adapted for corn, and the latter for vines. The best soil is in the middle between the mountains and the sandy plains. In Bohemia, Silesia, Franconia, Saxony, and on the Rhine, the proportion of good soil is very much greater than in the north or the south.

Mountains.

Some of the loftiest mountains of Germany are those springing from the great mass of the Alps, and divided into the Rhetian and the Noric; and several of the peaks of those reach the line of perpetual snow. The eastern branch of the Noric chain runs through the Austrian dominions, and loses one part of that chain in Silesia, whilst another enters Hungary. The other branch runs through Bavaria and Wirtemberg, to the west of the Black Forest; and is connected with the Odenwald, the Fichtelberge, and the mountains of Thuringia. It stretches to the Hartz, and the mountains through which the Weser forces its passage; soon after which it is lost. Several other chains branch from these greater ones; and some of their peaks attain a considerable elevation. The principal mountains, and their height above the level of the sea, are as follows: but, in their progress to the north, their gradual declension in height is remarkable;

	Feet.
The Ortel, in the Rhetian Alps, -	14,416
The Grossglockner, in the same, -	11,982
The Vichbachhorn, in the Noric Alps,	10,826
The Terklon, in the Carnic Alps, -	9,744
The Hochvogel, in the Alguer Alps, -	9,000
The Grosenberg, in the Styrian Alps, -	8,380
The Eisenhuth, in the Julian Alps, -	7,680
The Schneeberg (near Vienna), in the Noric Alps, - - -	6,858
The Olscher, in the Noric Alps, -	6,062
The Traunstein, in the same, - -	5,365
The Schneekuppe, in the Reisenberg,	4,950
The Feldberg, in the Schwartzen wald,	4,610
The Rachel, in the Bohemian forest, -	4,282
The Speiglitzer, in the Mácher mountains,	4,280
The Fichtelberg, in the Erzebirge, -	3,731
The Dammersfeld, in the same, -	3,640
The Schneeberg, in the Fichtelgebirge,	3,621
The Brocken, in the Hartz, -	3,489
The Hohe-Eule, in the Glatzgerbirge, -	3,326
The Beerberg, in Thuringia, - -	2,985
The Inselberg, in the same, -	2,791
The Feldberg, in the Taunus, -	2,605
The Meissner, in the Warrageberge, -	2,180

Germany.

	Feet.
The Müggelsberg (the highest in Brandenburg),	340
The Rekuhl (the highest in Pomerania),	280

The mountains are generally covered with forests; to the southward, where they are the most lofty, with pines; and to the northward, with various deciduous trees. If, at the present day, the *Terra sylvis horrida* of Tacitus cannot be found in Germany, it is still the most abundantly wooded territory in Europe.

Rivers. Germany has seven large rivers which pass through it to the sea; and, in their passage, receive the various smaller streams which issue from the mountains, and spread fertility over this well watered country. The Danube rises in the Dukedom of Baden, becomes navigable for small craft at Ulm, receives the large rivers Loch, Iser, Inn, Ens, and March; and, after a course of 430 miles, exclusive of its curvatures, waters Hungary in its way to the Black Sea. The Rhine, rising in Switzerland, and navigable from its entrance into Germany, has a course, exclusive of its windings, of 460 miles, before it enters the kingdom of the Netherlands. In its progress, it receives the navigable rivers Neckar, Lahn, Moselle, the Saar, the Roer, and the Lippe.

The Weser rises in middle Germany, from two springs which form the Fulda and the Werra, and at their junction takes the name which it carries to the ocean, and under which name it runs, without noticing its bendings, 190 miles. It becomes navigable at Minden for boats, and at Vegefach, near Bremen, for ships. The Elbe, like the Weser, from its rise to its junction with the ocean, is wholly a German river. It becomes navigable near its source, runs a course of 520 miles, and is the most considerable channel of commerce with foreign countries, through the ports of Hamburg and Altona. It receives the navigable rivers Moldau, Eger, Saale, Havel, Spree, Ilmenau, and Steckinitz, besides fifty smaller streams. The Oder becomes navigable for boats at Ratisbon, and running in the Prussian part of Germany, a course of 380 miles, empties itself into the Baltic Sea in Pomerania. It receives the rivers Bober, Neisse, and Warthe, besides many smaller streams. The Eloch is the only German river that runs to the Adriatic Sea. It passes through the Tyrol, and only becomes navigable after it has entered Italy. The Ems is a river of short course, rising in Prussia, and passing through Hanover, whence it becomes navigable, and soon enters the sea near the city of Emden in two branches.

Canals. The forming a junction between these great rivers, by means of canals, is an object of vast importance, and some progress towards effecting it has been made. The Holstein canal unites the German Ocean with the Baltic Sea from the river Eider. The Plauen canal unites the Havel with the Elbe, or rather facilitates and shortens the passage. The Finnow canal forms a communication between the Havel and the Oder. The Fredrick Williams canal unites the Spree and the Oder. The Pappenburg canal is designed to unite the Ems with the Elbe. Lastly, the Vienna canal, of which but a small portion is yet completed, will, when finished, form a communication between the Danube and the Adriatic Sea.

Germany.

Climate. The whole of Germany being in the temperate zone, though, with the variations of elevation and the difference of latitude, it differs in climate, is generally very healthy. The most mild and beautiful are the middle provinces, between the 48th and 51st degree. In the south, under the influence of the Alps, the air is raw and cold, whilst in the plains and open vallies, the climate of the finest parts of Italy is enjoyed. The northern provinces are colder, damper, and more ungenial, and near the stagnant lakes unwholesome. The weather changes to great extremes, and the frost is frequently seen at a late period of the year. The inhabitants there too feel the effect of heavy fogs, and sometimes of tremendous storms. No volcanoes are now in existence, and though the remains of them are to be seen in many places, they are not supposed to have been in a state of activity since the Antediluvian ages. Earthquakes are scarcely felt, and have never been injuriously experienced, and the country is free from the musquitos, which so much annoy the people of Italy. Vines, maize, and rice, grow as far north as latitude 51. Beyond that, they do not arrive to full perfection. The olive and the silk-worm are only raised on that small portion of Germany to the south of the 46th degree.

Animals. — Horses. The original German horses are of a very inferior race, and the specimens of them, where they have not been improved by the mixture of other breeds, generally bad; but from this must be excepted those of Mecklenburg, East Friesland, Holstein, and Luneburg, which, for draft or for heavy dragoons, are admirable races, and have been propagated over all Europe. Horses for pleasure, or for mounting light cavalry, must be brought from other countries, but the jennets, a light small breed, are good and quiet. Asses are not common even in the southern part of the country. Mules are to be seen in Hanover, near the Hartz forest, and in the Tyrolese portion of Germany they are the common beasts of burden.

Cows. The cows are of various breeds; but the handsomest are those from East Friesland, Oldenburg, Holstein, and the other provinces on the borders of the German Ocean, though generally known under the name of East Frieslanders. The Hungarian breed prevails in many parts, but are esteemed more for the ease with which they are fattened than for the purposes of the dairy. A third sort of cows is the Swiss bred, which does not come wholly from the Alpine regions, but is furnished by Wirtemberg, and a part of Bavaria. The breed of Germany, originating from the mixture of these races, is well adapted for the dairy; but, either from want of appropriate qualities in the animals, or from the imperfect manner of fattening them, the oxen, when killed, are seldom more than 500 pounds weight, and the average of them considerably lighter. Some attempts are now making to improve the breed, by the introduction of the Tyrolese bulls; perhaps the most per-

fect animal of the cow kind for meat and for draft, who, when crossed with the best milkers, produce the most complete cattle. The common practice in Germany, of killing the calves from ten to sixteen days old, produces very bad veal; but some of the beef, especially near the banks of the Elbe, is excellent.

Sheep.

The proper German sheep are a mixture of the original coarse-woolled race, crossed by a breed from Ardennes. In a part of Illyria, they have the sheep of Padua. The fine-woolled sheep of Spain have, however, been introduced by many of the Princes, and have been vastly extended, especially in Saxony, Silesia, and Brandenburg, and will probably, at no distant period, be the principal, if not the sole race. The badness of their flesh is of less consequence in Germany than in England; because, in the former country, it is not worth more than the annual clipping of the wool, which can be sent to richer countries, where they can afford to pay high prices for it; but the flesh must be consumed at home, and therefore sells for little.

Swine and Goats.

Goats are common in all the States, but are only to be seen in large flocks in the more mountainous parts. Swine are the most important kind of live stock in Bavaria, Westphalia, Hanover, Mecklenburg, and Pomerania. They are of three different breeds; the long white bent in the back; the short white, or yellow, with the same kind of back; and the black, or yellow, of a short make; but these different breeds are becoming much mingled together.

Wild Animals.

The forests of Germany abound with untamed animals, which afford sport to its princes and nobles, and furnish a considerable quantity of aliment to the higher and middle classes of the people; as the noble sportsmen generally sell their prey, and are obliged to dispose of it cheap. Wild deer of various kinds, and wild swine, are very numerous in many parts of the country. With them, foxes are found in some districts in prodigious numbers. At a hunting on the estate of one nobleman in Bohemia, on three days of 1818, more than 12,000 head of game was killed; and, in Saxony, between 2000 and 3000 hares were shot in one day, and sold for about 1s. each. There are bears in the southern parts in Illyria, in the Steyermark, and the Tyrol, of the small black kind, more dangerous to the bee-hives, and the smaller animals, than to man. Wolves are few now, and only in the Trans-Rhenish provinces. In some of the mountains, the beaver is found, though now but rarely, and some other animals, principally valuable for their fur. The most annoying animal is the field-mouse, of a species called the hamster, which are found in thousands in Saxony, and do incredible injury to the productions. In the months between the 9th May and the 9th of September 1817, the corporation of the city of Gotha paid rewards for killing 89,565 of these mischievous animals.

Birds.

Domesticated birds are very plentiful, but especially ducks and geese. The latter form an important portion of the food, on many of the farming establishments, especially in Pomerania, Bohemia, and the Steyermark; where most houses in the country cure from 50 to 100 for their winter consumption. Wild birds are more numerous in Germany than in any other part of Europe. Wild geese, bustards, grouse, black-cocks, wood-cocks, wild-ducks, widgeons, teal, and snipes, are most abundant. Besides these, the smaller kinds of birds, as larks, thrushes, and sparrows, and the singing birds, especially bullfinches and canary birds, are plentiful. The latter are chiefly taken in the Hartz forest, and are circulated through all Europe.

Fish.

The three seas that border on Germany abound with fish. Besides the kinds which are caught in the ocean, the Baltic Sea and the Adriatic furnish their peculiar species. Among those of the former is the Dersh and the Klipfish (*Anarchicos*), and the latter the Tunny, the Sardinia, and many others. The greater part of the fish consumed in Germany is, however, the produce of the rivers and lakes, which supply them in great abundance with eels, lampreys, trout, salmon, sturgeon, perch, pike, salmon-trout, barbel, carp, craw-fish, and many others. With these various kinds, the markets in the cities are most profusely supplied.

Bees.

The rearing of bees in the north, and especially in Lusatia, is productive of much honey and wax, which form important articles, both for domestic use and foreign trade.

Corn.

The great production of Germany, as of every other European country, is grain of various kinds. Wheat, rye, maize, rice, barley, oats, beans, pease, and buckwheat, are the most important of these. In the south, more wheat than rye is grown; but, in the north, the proportion of rye to wheat is eight to one. In the north, most oats are cultivated; in the south, more barley. Maize and rice are peculiar to the south; buck-wheat and pease are alike in every part.

Culinary Vegetables and Fruit.

The productions arising from garden culture are very great. Potatoes are sometimes cultivated with the spade, sometimes with the plough; but the increase of their growth has been very rapid of late years, and probably furnishes as much human aliment as grain. The cabbages of all the Brassica tribe receive much attention, and are raised in great quantities. Turnips are cultivated with little care merely as food for man, and are not extensively used for feeding cattle. The superior kinds of fruit are best in the middle and southern provinces; but, in the north, the apples, plums, and pears, are good and most abundant. The Pearmain apple, which has spread through all the countries of Europe from Germany, is found in the highest perfection in Stettin, Bostock, and the Tyrol. Chesnuts and almonds are almost exclusively grown in the southern parts towards Illyria and the Tyrol; and in the same vicinity the melons and other fruits, that in our climate and the north of Germany require artificial heat, are raised in the open air.

Wine.

Vines were originally planted in Germany by the Romans. They are now cultivated successfully on the banks of the Rhine, the Maine, the Moselle, the Danube, the Mur, the Etsch, and the Save, where they produce wine as highly esteemed as any in Europe. The most valued of all the wines is that on the banks of the Rhine, known in England by the

Germany. name of Old Hock, from the vineyards of Hockheim, where the best kind is made. The principal sorts, from the places of their growth, are denominated Johanisberg, Rüdesheim, Hockheim, Markobrunn, and Lieb-frauenmilch. The next in value are the wines of Maine, called Leisten wine, Stein wine, and Steyer wine. The wines from the Danube are next in estimation, and to them succeed those from the Tyrol and the banks of the Moselle. The other wines near the lake of Constance, and in Bohemia, are much inferior; and those produced near to Naumberg, Jena, and Meissen in Saxony, and to Zullichau in Silesia, are of very indifferent flavour, especially after a moist summer, and scarcely merit the name of wine, though, from their great abundance, they become very useful to the inhabitants.

Oil. Neither the quantity nor the quality of the oil produced from olives in Germany is material; it is confined to a small district of the south. Great quantities of rape and linseed oil are expressed, and for the more common purposes, the oil of herrings, seals, and other aquatic animals, is very abundant.

Vegetables for Commerce. The staple production of Germany is flax, which is grown in almost every village, and is spun into yarn. The best is produced in Silesia, in Westphalia, in Hanover, in Brunswick, and in Bohemia; but even these kinds do not attain a length or fineness of fibre equal to the flax of Flanders. Hemp is raised in Baden, Wirtemburg, Westphalia, Hesse Darmstadt, and Luneburg, but scarcely produces sufficient for the consumption of the country. Tobacco has been long cultivated in Baden, on the Rhine, and near Magdeburg, and during the existence of the French continental system, had been extended very much; but the return of peace has checked its progress, and it will, in future, only be cultivated in those parts here mentioned, where, from long habit, it is become almost indigenous. Various roots have been cultivated for the production of sugar during the continuance of that system, but they now scarcely deserve notice, as they are nearly abandoned. Woad, saffron, annise-seed, cummin-seed, hops, rhubarb, chamomile flowers, and Iceland-moss, are native and considerable productions. The forests of Germany, besides their abundant supply of fuel to the inhabitants, furnish much wood, both for building houses and ships; and if ever the water communication should be much extended, so as to bring the largest trees with facility to the shores of the ocean, they will become a most valuable source of wealth.

Earths and Minerals. No part of Europe yields a greater variety or abundance of mineral productions, and in no part of the world are the mines worked with so much skill or so much economy. Precious stones are discovered in many parts; rock-crystal, amethysts, topazes, are found in Bavaria; calcedony, agate, petchstein, and porcelain-jasper, in Bohemia; barytes in many parts; marbles, gypsum, and alabaster, in Bohemia; alum near Toplitz; rock-salt and Glauber salts in various parts, and abundance of the earths calculated for making earthenware, from the coarsest description to the finest porcelain. Fossil coal is found in many districts, and much of it is consumed; but the cheapness of wood, and the prejudices of the people against the use of it in their houses, has operated to prevent the mines from being completely explored or worked to any thing approaching the extent of which they are capable. Gold is procured, though in small quantities, by washing, in Saltzburg, in Bohemia, in the Rammelsberg, and in Silesia. Silver and cinnabar are raised from the mines of the Erzegebirge in Saxony. Iron, copper, tin, lead, calamine, bismuth, cobalt, nickel, titanium, arsenic, and almost every other mineral, is more or less raised from the mines. The abundance of mineral substances every where scattered, and which, it would be difficult to epitomise, have promoted the study of mineralogy, and given birth to the school of Freyburg, from whence, under the direction of Werner, the mineralogical knowledge of the earth has been widely extended.

The annual supply from the mines of Germany is as follows:

Gold, . .	1,456	ounces.
Silver, . .	984,000	do.
Copper, . .	39,000	hundreds.
Lead, . .	191,200	do.
Tin, . .	7,800	do.
Iron, . .	2,400,000	do.
Quicksilver, .	6,180	do.
Cinnabar, .	7,800	do.
Cobalt, . .	16,500	do.
Calamine, . .	82,800	do.
Arsenic, . .	10,600	do.
Antimony, . .	2,400	do.
Rock-salt, .	5,150,000	do.
Fossil coals, .	20,000,000	do.

Population. The population of Germany, given *in this* Volume, p. 203, Art. EUROPE, approaches as near to accuracy as is almost ever found; and the very trifling differences between that and what is here furnished, arises from later lists having been obtained within a few months; and from the parts of the Austrian, Prussian, Danish, and Netherland dominions, that are connected with Germany by the general confederation, being combined with the other states.

Population and Extent of the States of the German Confederation.

	Inhabitants.	Square English Miles.	Seats in the Assembly of the States.
Austria, . .	9,496,853	78,912	4
Prussia, . .	8,187,220	70,549	4
Bavaria, . .	3,513,490	30,997	4
Saxony, . .	1,206,034	7,200	4
Hanover, . .	1,314,124	14,720	4
Wurtemberg, .	1,397,451	7,524	4
Baden, . .	1,001,630	5,803	3
Carry over.	26,116,802	215,705	27

Germany.

	Inhabitants.	Square English Miles.	Seats in the Assembly of the States.
Brought over,	26,116,802	215,705	27
Hesse-Cassel,	545,208	4,352	3
Hesse-Darmstadt,	633,026	4,117	3
Holstein,	359,985	3,691	3
Luxemburg,	214,058	2,347	3
Saxe-Weimar,	192,371	1,408	1
Saxe-Gotha,	182,311	1,152	1
Saxe-Meiningen,	56,269	384	1
Saxe-Hildburghausen,	29,706	213	1
Saxe-Coburg,	80,012	471	1
Brunswick,	209,527	1,514	2
Mecklenburg Schwerin,	351,908	4,755	2
Mecklenburg Strelitz,	71,769	768	1
Oldenburg,	225,349	2,752	1
Nassau,	302,769	2,164	2
Anhalt Dessau,	52,947	363	1
Anhalt Bernburg,	37,046	340	1
Anhalt Kothen,	32,454	331	1
Schwartzenburg, Sonderhausen,	45,120	384	1
Schwartzenburg, Rudolstadt,	53,940	448	1
Hohenzollern, Hechingen,	14,500	117	1
Hohenzollern, Sigmaringen,	37,032	426	1
Liechtenstein,	5,546	53	1
Reuss, elder branch,	22,255	153	1
Reuss, younger branch,	52,205	458	1
Lippe-Detmold,	69,062	436	1
Schaunburg-Lippe,	23,684	213	1
Waldeck,	51,877	459	1
Hesse Homburg,	19,823	138	1
Frankfort,	47,372	113	1
Lübeck,	43,127	122	1
Bremen,	46,270	72	1
Hamburg,	129,739	134	1
	30,355,069	250,552	70

The inhabitants are of two original races, the ancient Germans and the Sclavonians. The former are divided into High and Low Germans, speaking a language somewhat different, but possess great similarity in habits, characters, and dispositions. The Low German, or, as it is called, *Platt Deutsche,* prevails among all the people in Lower Saxony, Westphalia, Holstein, Mecklenburg, Brandenburg, and Pomerania; but as the service in the churches, and the instruction in the schools, is in High German, all even of the peasantry understand that language, but prefer their own dialect. In the southern parts, where only High German is spoken, the peasantry use a *patois* that is scarcely more intelligible to those unaccustomed to it than the *Platt Deutsche.* The descendants of the Sclavonians reside all to the eastward of the Elbe. They retain their original language, with a great mixture of German words. They are far behind their neighbours in cultivation, but are an industrious and patient people. They form nearly one-sixth of the inhabitants. In the south are some few of Italian origin; and colonies of French, originally Protestant refugees, are established in many places, where they retain a connection with each other, founded upon privileges granted at the time of their emigration. The whole of these scarcely amount to more than 250,000. The Jews are 248,749 souls; of whom 83,077 are in Austria, 57,353 in Prussia, 22,000 in Bavaria, 8,319 in Wirtemberg, 8000 in Hanover, 8300 in Hesse Darmstadt, 15,079 in Hesse Cassel, 14,378 in Holstein, 16,000 in the free cities, and the remainder are scattered over all the other states.

Religion.

By the terms of the Confederation, the three Christian sects, Catholics, Lutherans, and Reformed, are on an equal footing in all the States of the Union, and the religious profession of the princes has very little influence on that of the subjects. The Catholics are the great majority in Austria, Bavaria, Baden, and Luxembourg, and form a numerous body in Prussia, in Wirtemburg, Hesse Darmstadt, Hesse Cassel, and Hanover: the whole number is 18,000,000 individuals. The Protestants of the two confessions have approached each other so nearly, as to form almost but one church; and, in many parts, they are amalgamated together. Their whole number is about 12,000,000. The smaller Christian sects, Menonites, Hussites, Moravians, and a few of the Greek church, are not together more in number than the Jews, who were before stated at about 250,000.

Learning.

The knowledge of the German people probably exceeds that of every other. They have men of eminence in every department of literature, and can enumerate those who have made discoveries or improvements in every branch of science. It is not, however, so much from the merits of their eminent men, great and useful as they have been, as from the general diffusion of knowledge, that the character of the nation must be estimated. Its literature is not the work of its princes and nobles, but arises from that general taste for reading and accumulating knowledge which so extensively prevails, and which descends lower in the scale of society than in any other country of the civilized world. Although, for two hundred years, literature has prevailed much in Germany, it was only about the middle of the last century, that, by the poets and critics, the language became polished, without diminishing its force, and was purified from many of those vulgarisms which disgusted the English, French, and Italian literati. The learned men had more sedulously studied the ancient languages of Greece and Rome, than the improvement of their own; but, in the middle of the last century, a race of authors appeared, with whom arose the commencement of the golden age of literature. Gotsched, Lessing, Adelung, and Campe, were among the first that imparted to their countrymen the knowledge of the powers and the beauty of their native tongue. Poetry soon lent its aid, and furthered what the prose writers had begun; it broke forth suddenly as from a dark cloud, and threw a radiance on almost every subject, that, in any age or country, the muse has ever attempted. With Haller, Gellert, and Hage-

Germany.

dorn, began that chain of poetic writers, which has continued to be extended to the present day. The poetical epistles of Michaelis, Ebert, Gotter, and Jacobi, will be ever read with delight. In descriptive poetry, Von Kleist, Thümmel, and Wolfgang, have been distinguished; but especially Goethe, whose name is known in every corner of Europe. In satire, Rabener, Musaeus, Lichtenberg, and Falk, excelled. In elegy, Höltz, Bürger, Weisse, Schmidt, and Herder. In fables, Gellert, Liessing, Willamow, and Pfeffel. In poetic tales, Wieland, Blumauer, Rost, and Nicolay. The name of Klopstock will ever be reverenced by those who venerate heroic or religious poetry. The lyric poems of Schiller, of the two Schlegels, of Bos, and Ramler, are beautiful specimens of the powers of the German language.

The theatrical productions have kept pace with the other species of poetical composition. In tragedy, Schiller, Goethe, Lessing, Collen, and Grillparzer, have distinguished themselves; whilst Ifland, Kotzebue, Brand, Grossman, Scroeder, and a host of other writers, have appeared in comedy.

German writers of prose have been neither fewer nor less able, though their names have not been so far extended in other countries, as those of the poets and theatrical authors. In religious compositions, Mosheim, Sack, Jerusalem, Spalding, Zollikofer, and Teller, are destined to futurity, after having delighted and edified the existing generation. In epistolary writing, few in any language have exceeded Gellert, Winkleman, Abt, and Garve, whilst Mendelsohn has been unrivalled in his dialogues. The race of novel and romance writers has been too numerous to be recited; and the latter have displayed a power over the human passions and feelings, which has scarcely had equal examples in the writers of other nations.

In didactic writings, those of Scheibart, Lessing, Winkelman, Iselin, Sonnenfels, Moser, Zimmerman, Eberhard, Bötticher, and Forster, have displayed great talent; and, on subjects of education, Basedow, Campe, Trapp, Salzman, and Pestalozzi, have discovered vast powers of mind, directed to one of the most important subjects.

In classical literature, the Germans have thoroughly imbibed the spirit of the ages when Greece and Rome were at the highest pinnacle of literary glory. The names of Ernesti, Heyne, Gesner, Camerarius, Fabri, Wyttenbach, Wolf, and Scheller, are familiar to the Latin scholars of every country; as are those of Michaelis, Hottinger, Von der Hardt, Eichorn, Griesbach, and Paulus, to the Greek student.

The Germans have been ever distinguished for that diligence and patience in examination and novelty, which are the great requisites for geographical and statistical authors. None have in any country exceeded Busching, and many living authors are now following his steps with equal success.

The Germans claim the honour of having been the revivers of the Grecian mathematics, and the glory of having ascertained, by their countryman Copernicus, the true system of astronomy. Kepler is asserted to be the father of dioptrics, Tschernhausen, the inventor of burning glasses, Leibnitz, the solver of the differential calculus, and Lieberkuhn, the greatest improver of the solar microscope.

Euler was distinguished by his powers of analysis, and Kepler, Mayer, Herschel, Bode, Von Zach, and Olbers, by their skill in astronomy. Metaphysics engaged the close attention of Wolf, Leibnitz, Kant, and their scholars, Fichte, Schelling, and Platner.

Although in natural history Germany has produced neither a Linnæus nor a Buffon, yet Blumenbach, Zimmerman, Pallas, and Fabricius in zoology; Haller, Gleditsch, Hofman, and Sprengel in botany; and Werner in mineralogy, would not be unfit associates of those great names.

In natural philosophy, the Germans claim for Guerike the discovery of the air-pump; for Fahrenheit the thermometer; and for Hausen the invention, and for Marun the perfecting, of electrical machines; and they are proud to reckon among their chemists the names of Stahl, Hofman, Margrof, Born, Klaproth, and Humboldt. In medicine, besides Paracelsus and Stahl, they boast, with good reason, of Hofman, Tissot, Haller, Unzer, and Hüefland, with many others of great though inferior name.

In jurisprudence, the Germans long took the lead in Europe; and, in theology, Luther and Melancthon have, by the translation of the sacred books and by their writings, produced a mighty change through all the most enlightened nations of Europe.

It is, however, somewhat singular that, in a country of so much learning and such research, in which antiquities have been sedulously studied, where the numismatic collections are so numerous, and where ancient documents are so carefully preserved, scarcely any historian has appeared, who deserves a higher name than that of a chronicler.

The fine arts have been cultivated, especially music, with much success. No nation has produced more celebrated composers than Glüch, Handel, Haydn, Bach, and, above all, perhaps, Mozart. Statuary has been practised more by Italians in this country than by natives. Painters have risen to no very great excellence, with the exception of Albert Durer, Kranach, and Holbein; and to those of a more recent date must be added Mengs; and, in our own time, Angelica Kaufman, Hackert, and one or two others.

Leipsic Fairs.

The circulation of books, produced from the pens of ten thousand writers, is facilitated by the two fairs of Leipsic, to which the publishers from all parts of Germany resort with the new works they have printed at their own residences. This general rendezvous becomes the focus of literary information. The publications are made known, their respective merits are discussed, and the different booksellers exchange with each other the production of their respective provinces, which are thus spread over the extensive country in which the language is used, with great regularity, and with a very trifling expence in advertising.

One evil is much complained of, the want of protection for literary property; which arises from the great number of sovereigns in whose dominions the

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same language is spoken. The best productions of the north are frequently pirated in the south. The King of Saxony has indeed prohibited the circulation of pirated editions at Leipsic during the fairs; but that is found insufficient to protect authors whose productions combine excellence with popularity. The average number of works published of late years at Leipsic have been about six thousand, amounting to about ten thousand volumes; which probably is more than all the other presses of Europe deliver. The press in Germany is nearly free, for though in some states there is a previous censurate, yet it is conducted on liberal principles, and seldom is exercised except on small political works that display more heat than light, or on the class of periodical publications of less than twelve sheets.

Education.

No other part of Europe enjoys advantages for education equal to Germany, especially the northern parts of it. The parochial schools are so universal, that none but the wilfully ignorant, or those of imperfect faculties, can be strangers to reading, writing, and the first rules of arithmetic. The schools for classical instruction, denominated *Gymnasiums*, *Pedagoguims*, and *Lyceums*, are found in almost every large town, and dispense learning at a very cheap rate. The universities are sufficiently numerous and sufficiently endowed to provide instruction in the higher branches of knowledge on terms nearly if not strictly gratuitous.

Universities.

Universities.	When Founded.	Religion.	Number of Professors.		Number of Students.
Heidelberg,	1346	Protestant,	45	1816	603
Prague,	1348	Catholic,	41	1817	879
Vienna,	1361	Catholic,	79	1817	1103
Wurtzburg,	1403	Catholic,	36	1817	331
Leipsic,	1409	Protestant,	41	1818	883
Landshut,	1410, 1810	Catholic,	48	1813	640
Rostock,	1419	Protestant,	34	1817	76
Freyberg,	1456	Catholic,	32	1818	837
Tübingen,	1477	Mixed,	44	1818	500
Marburg,	1527	Protestant.	42	1812	197
Jena,	1557	Protestant,	39	1818	522
Giessen,	1607	Protestant,	37	1816	241
Kiel,	1667	Protestant.	29	1816	107
Halle,	1694	Protestant,	51	1818	471
Breslau,	1702	Mixed,	51	1818	490
Göttingen,	1734	Protestant,	80	1817	1065
Erlangen,	1743	Protestant,	29	1817	143
Berlin,	1808	Protestant,	58	1817	942
Bonn,	1818	Mixed,	—	1819	405

Besides these universities, there are in almost all the capitals of every state institutions for instructing pupils in the various learning of the medical, clerical, legal, and military professions; and of agriculture, mining, and the management of forest lands. There are also abundance of learned societies spread over the whole of Germany, many of whom have, in the course of years, been enabled to assemble such large collections of natural and artificial curiosities, as afford able assistance to those engaged in the pursuit of knowledge.

Libraries.

The public libraries, collected in the different cities, far exceed any thing that has been known in other countries. These valuable collections are managed with the greatest liberality; all of them are open for inspection and perusal at all proper seasons; and from most of them the readers may be supplied at their own residence. They thus become active and efficient fountains of knowledge. It would be tiresome to give a list which should comprehend all those, the number of whose volumes exceed 10,000; but we shall present one of those whose volumes are not less than 50,000: viz. Vienna, 550,000 volumes, including manuscripts and local and temporary works; Munich, 400,000 volumes in the royal central library; Göttingen, 280,000 volumes, including some thousand valuable manuscripts; Dresden, 250,000 printed volumes, and 104,000 manuscripts and small works; Wolfenbuttle, 190,000 printed volumes, 44,000 manuscripts, and 6000 Bibles; Stutgard, 170,000 volumes, besides 12,000 Bibles, of all languages and editions; Berlin, 300,000 volumes, in seven public libraries; Weimar, 110,000 volumes and 20,000 smaller works; Prague, 110,000 volumes; Frankfort, 100,000 volumes, in several public libraries; Hamburg and Breslau have 100,000 each in their public libraries; Mentz, 90,000; Darmstadt, 85,000; Cassel, 70,000; Gratz, 70,000; Gotha, 60,000; Marburg, 55,000; Jena, 50,000. The number of books in all Germany, in such libraries and other institutions as are open to the public, has been estimated at 5,000,000 volumes.

Cabinets.

The collections of pictures and of antiquities are correspondent in extent and excellence to the public libraries. The gallery of Dresden, now that those pictures plundered by France have been sent from the Louvre to the places from whence they had been taken, is the first in Europe. The collections at Berlin, Brunswick, Cassel, and Augsburg, are very fine; and many private assemblages of pictures, particularly those of the Princes Liechtenstein, Kaunitz, Esterhazy, and of Count Schönbrun, are of the first class. The antique cabinets of Dresden, Munich, and Cassel, are filled with curiosities from remote ages and distant nations; and the cabinets of natural history at Vienna, Berlin, Dresden, Cassel, Manheim, Jena, Munich, and Gotha, are most richly filled.

Agriculture and Rural Economy.

The greater part of the land in Germany is held by those ancient feudal tenures, which formerly prevailed in every part of Europe. The possessors of the soil, of whom, in every state, the sovereign is by far the greatest, have under them a species of customary tenants, called subjects (Unterthaner), who have the cultivation of common fields divided into small portions, without the intervention of fences. As soon as the corn is removed from the field, the lord has the right of pasture; and from these circumstances, it is impossible to deviate from an ancient practice, by which the different portions of the common land must be devoted to particular kinds of crops at specific periods. The rotation almost universally prescribed, known by the name of *drey feld*

Germany. *Landwirthshaft*, consists of a fallow, succeeded by two crops of grain. The fallow, however, generally bears a crop, which is usually either flax, pease, or (very commonly of late) potatoes; in consequence of a crop on the fallow, the land is seldom properly cleaned of weeds. To this fallow crop generally succeeds winter corn, either wheat or rye; but, in the north, the proportion of the latter to the former is as four to one, and in many parts, especially in Pomerania, ten to one. In the southern states, the two kinds of grain are nearly equally cultivated. To the winter corn succeeds barley or oats, as the land is better adapted for one or the other; or as may have been settled between the ancestors of the present lords, and their tenants in remote periods. By this mode of cultivation, the earth yields but a small increase. The tenants can keep but little live stock, and therefore make but little manure. The live stock they do keep is generally fed through the winter with straw, and the addition recently of potatoes, with a small portion of corn, and what dung they do produce is consequently of a very weak quality. These tenants are commonly holders of small portions of land, and that, in many instances, is necessarily divided at their decease among all their children; thus, the evil of the cottage system of small farms is clearly experienced. The villages are crowded with little proprietors, who have not either the conventional or the pecuniary power to improve the soil, who live in a state inferior to labourers, and who, from the smallness of their farms, can only obtain subsistence, by living on the cheapest diet, which of late, as in Ireland, is principally potatoes. Upon this system, the number of husbandmen increases with considerable rapidity; they form soldiers, and when called out by the military conscriptions of their princes, are placed in a better situation than when living on their farms.

In this condition of the community, the only land that can be well cultivated is the small portion of demesne which is in the hands of the lords, who, from their stock of cattle, could make manure to dress and improve the soil. These demesne lands are, however, though cultivated for the lords, ploughed by the tenants, who are bound by their tenures to do certain stipulated work for their superiors. The consequence of this is, that the work is badly performed, and at such seasons as best suits the tenant's own labour. The demesnes too feel the want of capital; for the lords have little besides their estates and the cattle upon them, and these being too generally left to the care of managers, who are less thrifty than as proprietors they would be, suffer considerably from that circumstance.

The foregoing sketch is a description of the practice on the far greater portion of the land in Germany; and, in consequence of it, the soil, though superior in original fecundity to the greater part of England, is gradually deteriorating, and does not at present yield more than five-eighths of what we raise on the same quantity of land. From the poorer classes eating nothing but rye or potatoes, and from having three-fourths of its population employed in agriculture, Germany is enabled to export corn in most years; but when an unpropitious season occurs the distress is dreadful, and is increased by the smallness of the different states, and the power being restricted of circulating grain freely from one to another; an evil which was severely felt and lamentably deplored in the calamitous year 1817. Germany.

The land of Germany produces but little beyond the absolute and indispensable wants of its inhabitants except in wine, flax, and wool. The culture of the vines is much less attended to than in France, and wine is the production but of a very small portion when compared with the whole extent of the country, whereas in France almost every part yields it. The quantity made in Germany is not calculated to be more than one-sixth of what France supplies; the whole is computed to be about two million pipes of one hundred gallons each; but a very small part of this finds its way to foreign countries.

The flax frequently forming, as before stated, the fallow crop, is important by the employment it affords, during the long and cold nights of their severe winter, to the female members of the peasants' families, and by the trade it creates in the export of its productions in the form of yarn or of linen cloth.

Wool is generally the property of the lord, and its annual clip is frequently the principal revenue derived from extensive possessions. This has induced many to pay great attention to the improvement of the wool, and much of it, especially from Saxony, is superior to any that the Merino flocks of Spain afford. It is within the few years that have elapsed since the expulsion of the French, that the great extension of the breed of fine woolled sheep has taken place. The implements of husbandry are in a very imperfect state, and as much so from want of information as from want of capital in Germany. The ploughs are generally small, light, and without a due curvature in the mould-board. The harrows are frequently of wood. That useful implement the roller is rarely seen, the waggons and carts are badly constructed, and the harness of all, either of ropes or twisted straw.

There are exceptions to these observations on the agriculture of Germany, but they are too few to merit any particular notice.

Manufactures. Germany is generally a manufacturing country, and can supply itself with, by far, the greater part of all the commodities that it needs. The manufacturers of that country are not placed in different districts, but in the same towns; and in almost every town of a moderate population, woollen, linen, cotton, silk, and iron wares are made. Thus their establishments are mostly upon a small scale, and they cannot avail themselves of those minute divisions of labour which are essential to the perfecting and to the cheapness of the goods. Linens are the most valuable article, and are made, from the coarse ones of Westphalia, which are used for negro clothing, to the finest shirting and table linen of Silesia and Saxony, and of all the intermediate qualities. Woollens, of all kinds, are made, and sufficient for the consumption; so that those of England and France are scarcely needed; nor do the Germans allow that any foreign fine cloth is equal, either in quality or price, to those manufactured in Saxony, Silesia, and the newly acquired Prussian provinces on the Rhine,

Germany. from wool of native growth. The Cassimeres and Vigonia cloths, in that last mentioned district in the towns of Eupen, Machren, and Aachen, are preferred to any that are brought from other countries. The fabrics of cotton had much increased during the continental system of exclusion, and had arrived at a considerable degree of perfection, but the return of tranquillity has checked the progress of all, and annihilated many. The most considerable districts for these kinds of goods are the kingdom of Saxony, the Prussian provinces of Juliers, Berg, and Cleeves, and on the banks of the Ens, in the Austrian dominions. The silk manufactures have never been considerable; some goods of the kind are made in many of the cities, but the principal establishments are in Vienna, at Roveredo, in the Tyrol, at Creveldt, at Cologne, and Berlin. Leather, iron, steel, and the wares prepared from them, are made at home. Porcelain and common earthenware are well made, and the two great royal manufactories of the first at Berlin and Dresden, equal any from Seve, from Worcester, or Etruria. The glass-ware of Bohemia, though of a very bad quality, is universally diffused, not only through Germany, but in most other parts of the world. Paper is a considerable article among the German manufactories. That for printing is coarse, and of a bad colour, and the writing paper is very imperfectly made. There are 506 mills, which deliver annually about 60,000 bales, but none of it goes to other countries. Chemical preparations are made upon an extensive scale, and comprehend alum, vitriol, smalts, white-lead, Prussian blue, sal-ammoniac, and verdigrease. Salt and sugar are refined for home consumption. Tobacco, snuff, wax, oils from plants, are also supplied from domestic manufactories. The quantity of beer furnished by the breweries in every town in the north is very great, and the distilleries of ardent spirits from grain is a most extensive manufactory, as is vinegar, mostly from grapes in those districts where they do not ripen sufficiently to be made into wine. The minuter articles, such as musical, mathematical, surgical, and optical instruments, with watches and clocks, are well and cheaply made. Wooden toys and plaited straw are important objects of employment to many of the inhabitants. Most of the fabrics of Germany are fettered by the laws of the guilds, or corporations, to which the masters are obliged to belong, and this acts as an impediment to their arriving at a high degree of perfection.

Commerce. The commerce of Germany, conducted by means of shipping, centers principally in the Prussian ports, or in the free cities, and may be best treated of under each of them. The commerce with France, Italy, Turkey, Poland, and Russia, is by no means great. The articles produced on the borders of each are too similar to cause a necessity for an interchange; and the heavier articles, that are produced at a distance from the respective boundaries, will, in few instances, bear the expence of land carriage. The trade that is purely internal, or among the different states, is much less than might be expected, and much less than it would be if there existed less of a monopolizing spirit among the cities, and less jealousy among the several sovereigns. The greater part of the internal trade consists in the sale of wines, and of foreign colonial produce, which the capitalists in the cities collect and sell in smaller quantities to the shops in the provincial towns.

General Constitution. The governments of Germany, with the exception of the four free cities, are all of the monarchical form, with some slight restraints from their states, as is narrated under each division. The whole is governed by an assembly of delegates from the various sovereigns, who have published a constitution, which is, however, so indistinct, and leaves such room for explanation, that it can scarcely be said to be in operation. The smaller powers, too, have from it little or no security against the invasion of their rights, or the aggressions on its interests that may be attempted. The principal object of the constitution, the *Bundes verfassung*, as stated by the confederates, is, to secure the internal and external tranquillity, and the independence and inviolability of each state. The details of it decide, that no member of the confederation shall make war on another, but defer to the decision of the assembly; that, in case of attack from without, no state shall make a separate peace or truce with the enemy; that no one shall enter into any engagements which can compromise the security of the confederation, or of any of its members; and that they shall always have ready an army, in the proportion of one to each hundred inhabitants, to defend the general confederation. By a special article, the three religious sects that divide Germany, the Catholics, Lutherans, and Reformed, are to be on equal footing in all the states.

Baden. Baden, a grand duchy, is the first of the German principalities. It is in the southern part of Germany, is bounded, on the north-east, by Bavaria, on the east by Wirtemberg and Hohenzollern, on the south-east by the Lake of Constance, on the south by Switzerland, on the west and north-west by France.

It is governed by the successors of the Margraves of Baden, with a constitution decreed in 1817, by which an assembly of nobles, and another chosen by the cities, divide the legislative power with the grand duke. The debt of the state amounts to about L.2,000,000 Sterling, the annual revenue L.550,000, the greatest part of which arises from the sovereigns' domains and royalties, and the remainder from the taxes paid by his subjects. The annual expenditure, including the interest of the debt, somewhat exceeds the income; and it is difficult to increase the taxation. The standing army in peace is about 8000 men, but is undergoing reduction; and the militia or landsturm, all of whom are regimented, is 92,000. The face of the country is generally irregular, with lofty hills, covered with woods, and rich and luxurious valleys between, that present the most picturesque prospects. The highest points of these mountains is Feldberg, 4610 feet above the level of the sea; and, with many others, is covered with snow eight months in the year. In the intervals between the mountains, the air is mild, and the spring and autumn both delightful and healthy.

The agriculture is generally on the three course rotation, but vines, almonds, and other fruits, are cultivated. The land under the plough is about 1,300,000 acres; the pasture land, 335,000 acres;

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the vineyards, 74,000; woods, 1,558,000; and the uncultivated parts, about 200,000 acres. Wheat is more cultivated than rye. Maize and rice are considerable productions, but being well supplied with wine, there is but little barley produced to make malt for beer and spirits. Potatoes are a very material article of subsistence, and are grown now even in many parts of the Black Forest. Hemp and tobacco are considerable productions. By the latest surveys, the number of horses of all kinds were 82,717; the number of animals of the cow kind were 201,576; the sheep, including their lambs, 179,986; goats, 22,047; and swine, 869,207.

The mining concerns are numerous but not large, and yield commonly 4750 ounces of silver, 400 quintals of copper, and 2000 of lead, 320 of cobalt, besides a large quantity of iron, the amount of which is not ascertained, but estimated at 20,000 quintals.

Baden is a manufacturing country for many articles, the value of which arise almost wholly from the labour employed on them. In some years 110,000 wooden-clocks have been made, and 50,000 dozen of pewter spoons. These are only a part of the numerous smaller kinds of ware which the ingenuity of the inhabitants prepare; besides these, they have manufactures of linen and woollen cloth upon a small scale.

The inhabitants, 1,101,630, consist of 469,472 males, and 532,158 females. The Catholics are 663,000; the Lutherans, 243,000; the Reformed, 82,000; the Jews, 15,000; and the Mennonites, 1200; all religions are equally established.

It has two universities, several public schools, and abundant institutions for the education of the lower classes of the people.

The divisions are six circles, viz.

Circles.	Extent in English Acres.	Inhabitants.	Capital.
Murg and Psintz,	737,280	189,736	Karlsruhe.
Kinzig,	664,960	164,811	Offenburg.
Treisam,	825,600	242,321	Freyburg.
Seekries,	755,840	145,262	Constance.
Neckar,	485,400	166,818	Manheim.
Mayne and Tauber,	349,720	92,182	Mertheim.

The cities with their inhabitants are, Manheim, 20,628; Karlsruhe, 15,789; Freyburg, 10,108; Heidelburg, 9826; Pforzheim, 5301; Constance, 4503; Rastadt, 4204; Weinheim, 4039; Mertheim, 3227; and Baden, 3085; the smaller cities which bear that name, because they have or have had fortifications, amount to one hundred, averaging not more than 1000 inhabitants each.

Hesse Cassel.

Hesse Cassel, a duchy in the middle of Germany, is very much divided by the intervening territories of Prussia, Hanover, Saxe-Weimar, Bavaria, and Hesse Darmstadt. The government is in the hands of the successor of the Landgrave, whose territory was merged in the kingdom of Westphalia, established by Bonaparte. The states, consisting of the nobles, the prelates, and the representatives of the cities, are some, though but a feeble, check on the sovereign, and their power is not accurately defined.

The income of the duchy is L. 380,000 Sterling, the expences somewhat exceed it. The debt is about L. 400,000, which was a novelty in Hesse Cassel before the occupation of it by France. The army is reduced, and, at present, consists of only 2000 men in constant pay, and 16,000 that exercise fourteen days in the year, and are paid during that term. The general face of the country is hilly, in some parts approaching to mountainous; but none even of the peaks exceed 3100 feet in height, and few of them 2100. The vallies between them are beautifully picturesque and highly fertile. All the provinces except Fulda and Hanau have been surveyed and measured. The land, under the plough, is 1,558,988; fruits and gardens, 393,906; meadows and pasture, 520,271; woods, 1,020,824; and wastes, waters, and the scites of towns and villages, 811,226 Hessian morgens (about eleven-sixteenths of an English acre). The two provinces that have not been surveyed are nearly three parts in twenty of the whole. Wheat, rye, barley, oats, and beans, are the grain produced, of which rye is equal to all the others. At the last enumeration of the cattle, there were 39,572 horses; 475 asses; 159,278 cows; 363,397 sheep; 25,438 goats; and 139,173 swine. The principal mineral is iron, of which about 64,000 quintals are produced; there are many parts abounding in fossil coal. The principal manufactory is that of linen, the coarser kinds of which have given the name of this duchy to most of the coarse unbleached linen of Europe. The other articles that are necessary for domestic use are made in the country, but few are exported. The religious enumerations are about 320,000; Reformed, 140,000; Lutherans, 90,000; Catholics, 8500; Jews, and a few Mennonites. It is divided into ten provinces, viz.

Provinces.	Extent in English Acres.	Inhabitants.	Capitals.
Lower Hesse,	1,187,840	245,621	Cassel.
Upper Hesse,	354,540	61,200	Marburg.
Hersfeld,	102,400	18,360	Hersfeld.
Ziegenhain,	138,340	27,922	Ziegenhain.
Fritzlar, .	83,830	15,328	Fritzlar.
Schmalkalde,	70,400	23,000	Schmalkalde.
Fulda, .	397,000	67,765	Fulda.
Isenburg, .	58,800	47,457	Birstein.
Hanau, .	279,680	62.666	Hanau.
Schauenburg,	129,280	26.911	Rintelen.

The principal cities and their population are, Cassel, 19,000; Hanau, 11,997; Fulda, 7468; Marburg, 6470; Hersfeld, 5222; Schmalkalde, 4697; Rintelen, 2666; and Fritzlar, 2266; the smaller cities and market towns are about eighty, but the far greater part of the inhabitants live in the villages.

Hesse Darmstadt.

Hesse Darmstadt, a grand duchy on the banks of the Rhine, which runs through the southern part of it, and is its principal boundary on the western side in the northern part. The sole government is, at pre-

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sent, in the Grand Duke, but he has pledged himself to convene the states this year (1820), and to form a free constitution. The revenues amount to about L. 500,000 Sterling, but are insufficient to meet the expenditure. The taxes are higher than in any other part of Germany, and the debt very heavy. The military forces, though reduced, still reach to nearly 7000 men, and a militia of the whole population. As a whole, the duchy may be termed hilly rather than mountainous, though some of the hills are near 2000 feet in height. In the northern part, on the hills the land is stony, in the vallies a heavy soil. In the southern part, the soil is generally sandy, and some of it totally destitute of vegetative power. More corn is grown than is generally consumed, but that arises from the lower classes being subsisted principally on potatoes. Some of the best wines are made in this state. It supplies other countries with fruit, nuts, madder, clover-seed, potash, honey, and wax, and with manufactures of yarn and linen. The religious denominations, and their numbers, are, 366,000 Lutherans, 140,000 Catholics, 98,000 Reformed, 15,000 Jews, and 1000 Mennonites. There are more nobles with extensive estates than in the other parts of Germany, and the peasants were in a state of slavery till they were liberated in the year 1813.

Hesse Darmstadt is divided into three provinces, viz.

Provinces.	Extent in English Acres.	Inhabitants.	Capitals.
Starkenburg,	698,520	220,263	Darmstadt.
Rhenish Hesse,	365,440	161,701	Mentz.
Upper Hesse,	1,233,520	248,674	Giessen.

The principal cities and their population is as follow: Mentz, 25,251; Darmstadt, 15,450; Offenbach, 6584; Worms, 6236; Geissen, 5500; Bingen, 3293; Alsfeld, 3019; Lauterbach, 2836; Biedenkopf, 2566; and Friedburg, 2548.

Mecklenburg Schwerin.

Mecklenburg Schwerin, a grand duchy in the north, is bounded on that side by the Baltic, on the east by Prussia, on the south by Prussia and Hanover, and on the west by the Danish dominions. The sovereign has his power divided by an assembly of the states, who meet to adjust the finances, and to sanction, but not to originate laws. The revenues amount to about L. 210,000 annually, and nearly equals the expenditure; the debts of the duchy are not more than L. 300,000, and are diminishing, and the taxes are light. In 1817, the army was reduced to 3600 men, which is the contingent to the army of the confederation. The whole of the country is a part of that vast plain which extends along the shores of the Baltic Sea. The agricultural productions are wheat, rye, barley, oats, pease, and beans. Wheat is about equal in quantity to rye. Barley is much more than oats. The corn exported in some years has amounted to L. 260,000 Sterling. The scarcity of wheat in England, during some years of the late war, gave a great stimulus to the cultivation of that grain, and has tended to improve its agriculture. When the ports of England are closed against foreign grain, a certain, though a lower, market is found in Sweden, where there is always a deficiency. The duchy is rather celebrated for its breed of horses; the cows produce butter beyond the consumption; and the sheep, whose race is becoming mixed by Merinos, is improving in the fineness of the wool. The trade of Mecklenburg is benefited by the river Elbe, which runs on its southern border, and by the ports of Rostock and Wismar, on the shores of the Baltic; the principal part of its corn is, however, sent through the free cities of Hamburg and Lübeck. Nearly the whole of the inhabitants are of the Lutheran confession; the other sects are, Catholics, 800; Reformed, 200; and the Jews, 2650. In Rostock is a university, and there are many public institutions adapted for all classes of the inhabitants in the duchy.

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The divisions are as follow:

Provinces.	Extent in English Acres.	Inhabitants.	Capitals.
Mecklenburg,	1,206,581	167,400	Schwerin.
Gustrow, . .	830,650	140,800	Gustrow.
Schwerin, .	79,067	24,800	Bützow.
Wismar, . .	23,680	11,400	Wismar.
Rostock, . .	only the city	14,334	Rostock.

The cities and their population are, Rostock, 14,334; Schwerin, 10,103; Gustrow, 7074; Wismar, 6692; Parchem, 3993; Ludwigslust (the residence of the Grand Duke), 3160; Bützow, 2659; and Botzenburg, 2317.

Nassau.

Nassau, a duchy which is surrounded by the Prussian dominions, except on the east, where it is bounded by Hesse Cassel, and a part of the south, where it joins the territory of Frankfort. The duke was an absolute sovereign till 1817, when a constitution was promulgated, by which his authority is divided with the states, but the operation of this new constitution is yet very doubtful. The revenue is about L. 180,000; the expenditure not quite equal to it; and the surplus is carried to a sinking fund to extinguish a debt amounting to L. 500,000. The military establishment is now reduced to 1688 regulars, and the remainder for the contingent must be drawn from the militia, which comprehends all between nineteen and twenty-five, with some few exceptions.

The country is generally hilly, in some places mountainous, and abounds with mineral springs, which, at Wiesbaden, Longenschwalbach, and especially Seltzer, have obtained great celebrity. From the last, 3,000,000 stone bottles are annually filled for distant consumption. The land is thus appropriated; under the plough 491,718 morgens; in meadows 139,350; vineyards 11,587; woods 525,305; the barren and waste land 108,930 Nassau morgens, which are to English acres as 27 is to 28. The best wines of Germany, the Johanisberg, with some other exquisite kinds, are produced in the duchy. It seldom raises sufficient corn for the consumption, but pays for what it requires in its wines. Its wheat is of

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excellent quality. The three course rotation is generally practised, and the land is usually ploughed with oxen. In the year 1818, the number of horses was 9735; asses and mules, 606; cows, 175,680; sheep, 172,737; swine, 64,103; and goats, 10,979. The manufactures are very inconsiderable; and though there are mines of silver, lead, and iron worked, their produce is but trifling. The two denominations of Protestants, now united in what is called the Evangelical Church, are 161,165; the Catholics are 135,041; the Jews, 5529; and a few scattered Mennonite families amount to about 850. There is no university, but the youths of good families generally study at Göttingen.

The duchy is divided into twenty-eight portions, called Justice and Domain Bailiwicks, in the capital of each of which is an inferior court of law. The whole population, when enumerated in 1817, was 302,796.

Wiesbaden, the capital of the dukedom, contains 5138 resident inhabitants; and in the season of the bathing, in some years, sees between 9000 and 10,000 visitors. The other cities are very small. Dillenberg has 2502; Limburg, 2303; Weilburg, 2171; and Rüdesheim, 2035. There are 55 smaller cities and market towns; 806 villages; and 1186 noblemen's seats and isolated farms.

Oldenburg.

Oldenburg, a duchy bounded by the territories of Hanover on every side, except towards the north, where it terminates on the shores of the German Ocean. It has, besides, two small portions of territory on the north side of the Elbe in Holstein, from whence it is called the Duchy of Holstein-Oldenburg. The duke is an absolute sovereign, uncontrolled by an assembly of the states, though a constitution is in contemplation to establish their meeting. The revenue is calculated at L. 120,000 Sterling, and the expenditure at something less; the debt is very trifling. The army is reduced to 1650 regulars; and if the confederation should demand the contingent, they may be made to reach 2180 by draughts or enlistment from the militia. The whole land is a plain mostly of barren sands, but with some rich meadows on which oxen are fattened, and much butter and cheese is made. The dams to prevent inundations on the richest land are numerous and expensive. The larger portion of the farms are not in villages, but at a distance from each other in the centre of the lands. The principal productions from the ploughed land are rape-seed and flax from the marshes. The upper land produces only rye and potatoes, and the crops of them are very scanty. A scarcity of wood is compensated by turf for fuel. The salted beef, bacon, hams, and sausages, are the means, by the sale of which, the inhabitants procure clothing and other comforts. The number of inhabitants is 225,389; the distinction of religions is not ascertained; the far greater part are Lutherans, who have 91 churches; the Catholics, 31; and the Reformed, 9. Education is more neglected than in any other part of Germany. The whole extent of the surface is 2630 English miles, or 1,488,320 acres. The capital city, Oldenburg, contains 5222 inhabitants; the others are, Jever, 3400; Hammelwarden, 3262; Elsfleth, 2808; Varrel, 2614; and Euten in Holstein, 2341. The population is, except Mecklenburg, the least dense of any state in Germany.

Brunswick.

Brunswick, a duchy, is surrounded by the Prussian dominions on every side, except the north-west, where it joins to the kingdom of Hanover. The sovereign is assisted by the states, who have the power of originating laws. The revenue amounts to about L. 380,000 Sterling; but more than half of it arises from the patrimonial domains of the duke. The expenditure is reduced below the income, and the debt left by Jerome Bonaparte of L. 1,000,000 Sterling is already considerably reduced, and is expected to be extinguished by the time the minority of the duke, who was born in 1804, expires. The regular troops are now reduced below 1400 men, and the remainder of the contingent, when needed, must be supplied by draughts from the militia. The country is generally very pleasant, well cultivated, and fruitful. The ploughed land is 291,575; gardens are 16,752; meadows, 42,059; inferior pasture, 207,751; woods, 284,423; fish-ponds and lakes, 2217 acres. The stock of live cattle, when last enumerated, consisted of 50,300 horses; 86,400 cows and calves; 258,965 sheep; 8291 goats; 116 asses and mules; and 8450 hives of bees. The situation, near the Weser and the Elbe, is favourable to commerce. The exports of linen yarn, linen cloth, fine wool, wheat, and rye, are computed at L. 250,000 Sterling; and those of rape-seed, oil, and oil-cake, of hops, madder, vitriol, sulphur, arsenic, zinc, cobalt, and some smaller wares, at L. 120,000 Sterling. A part of the Hartz forest is in Brunswick, which supplies these minerals. The divisions are,

Districts.	Extent in English Acres.	Inhabitants.	Capitals.
Wolfenbuttle,	291,840	56,593	Wolfenbuttle.
Schöningen,	189,160	32,880	Helmstadt.
Hartz, .	133,760	19,841	Langelsheim.
Line, .	60,800	15,748	Gandersheim.
Weser, .	161,280	31,468	Stadtoldendorf.
Blackenburg,	92,140	16,317	Blankenburg.
City of Brunswick, .		29,050	
City of Wolfenbuttle,		6,800	

The population of the other cities, besides the two noticed, is thus, Helmstadt, 5259; Holzminden, 3304; Blankenburg, 2768; Königslutter, 2493; Scheppenstedt, 2030; and Leesen, 2011. The religion is Lutheran, which is professed by all the inhabitants except 2072 Reformed, 1046 Catholics, and 1048 Jews. All religions are, however, upon an equal footing with regard to all civil rights. The only university, that of Helmstadt, has been lately suppressed from motives of economy. There are several public schools, and the superior education is received from Göttingen. The Duke of Brunswick has also the Dukedom of Oels in the centre of the Prussian province of Silesia. It contains 508,800 acres, with nine towns, 334 villages, and 87,800 inhabitants. The revenues are about L. 22,000 Ster-

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ling, but it is involved in debt, and produces no income, but the same wise administration is extended to it, and is expected to clear the incumbrances.

Saxe Weimar.

Saxe Weimar, a grand duchy, divided into two distinct portions by the intervention of the Prussian district of Erfurt, and the duchy of Saxe Gotha. The sovereign is assisted by an assembly of the states, by whom new laws must be sanctioned and new taxes imposed. The revenue is about L. 150,000 Sterling, and so far exceeds the expenditure as to be enabled to apply L. 9000 *per annum* to the extinction of the debt incurred by expelling the French, which, in 1818, was L. 600,000 Sterling. The taxes are very light, and the standing army, with the exception of three companies which are not full, is abolished. The militia will form the contingent if it should be required. The eastern part of the dukedom is light sandy land, cultivated on the three course rotation, and producing much more rye than wheat. The western part is mountainous, and, in the valleys, contains some excellent land. The manufactures are but trifling, barely enough for domestic consumption.

It has long been the most favoured seat of learning and genius, and has produced so many great names, that the capital Weimar is considered the Athens of Germany. At one period, three of the greatest literary men were living there, Schiller, Goethe, and Herder, and of the inferior ranks of authors Musaeus, Falk, Kotzebue, and many others, and now the number of men of superior abilities is considerable. The establishment for writing and printing books, and for composing, engraving, and printing maps, is perhaps the largest literary undertaking in Europe.

The religion is Lutheran, but other sects have equal rights; they are, 6100 Reformed, 100 Catholics, 1100 Jews, and a few Mennonites. It is divided into two principalities, Weimar and Eisenach. Wiemar contains 600,320 acres, and 137,000 inhabitants. Eisenach contains 286,720 acres, and 65,549 inhabitants. The University of Jena is in this duchy, and was formerly very celebrated, but late events have diminished it much. The cities and population of them are, Weimar, 8232; Eisenach, 8258; Jena, 4459, besides the university; Neustadt, 3319; Apolda, 3036; Beyda, 2236; Ostheim, 2187; and Ilmenau, 2140.

Saxe Gotha.

Saxe Gotha, a duchy divided by the dominions of Prussia and Saxe Weimar. The duke governs with the intervention of the states; the revenues amount to about L. 150,000 Sterling; some secrecy is observed, but the revenue is supposed to exceed the expenditure, and nearly to extinguish the debt of the general government. The regular troops are 1960 men, being more than the contingent. It is a beautiful, fertile, and well cultivated country, yielding every thing necessary for subsistence and much for commerce. In the province of Altenburg the cultivators are the richest and most skilful in Germany. In every part are manufactures of linen, cotton, woollen, and various other articles, and, besides what is consumed at home, much fine wool is exported.

The whole of Saxe Gotha is that fine corn bearing land, known in Germany by the name of the Golden Mountains of Thuringia. It is mostly very elevated land; and the city of Gotha, the capital, by the measurement of Baron Zach, is ascertained to be 1200 feet above the level of the sea. It is divided into two principalities, that of Gotha and of Altenburg. Gotha extends over 409,360 acres, and has 105,201 inhabitants. Altenburg is 348,160 acres, and contains 81,936 inhabitants. The religion of the duchy is Lutheran, and almost all the inhabitants are of that profession. There are no sufficient numbers of the Catholics or Reformed churches to have establishments, but the Herunhaters or Moravians have a considerable community.

The cities and their population are, Gotha, 11,080; Altenburg, 10,164; Römhild, 5984; Ronneburg, 4178; Eisenberg, 3943; Ohrdruff, 3372; and Waltershausen, 2310.

Saxe-Coburg-Saalfeld.

Saxe-Coburg-Saalfeld, a duchy adjoining to Saxe Gotha. The duke is sovereign, and as yet without assembling the states. The revenue is about L.60,000 sterling. The expenditure is nearly equal, the debt uncertain. The forces are reduced to 250 men. The ancient possessions are hilly; the new acquisitions are more level. The rotation of crops is almost universally a fallow crop, winter corn, and then summer corn; but a clean fallow is occasionally introduced. The cows are the most important live stock; but the sheep are numerous, and all of the fine wool kind. The only large manufactories are of linen. Some copper and a little silver is produced from the mines. The prevailing religion is Lutheran, of which there are 76 churches. The Catholics have 13, and the Reformed 3. It is divided into three principalities, viz. Coburg, Saalfeld, and Lichtenberg. Coburg is 129,280 acres, and contains 35,327 inhabitants. Saalfeld is 115,840 acres, and has 21,392 inhabitants. Lichtenberg is 152,320 acres, and contains 26,315 inhabitants. The cities are, Coburg, with 8154 inhabitants; Saalfeld, with 3497; and Wendell, with 2003, besides some smaller ones.

Saxe-Meinengen.

Saxe-Meinengen, a duchy, divided, like all these smaller independencies, by the intervention of the dominions of other sovereigns. The duke is checked by the assembly of the states in financial matters. The revenues amount to about L.35,000 *per annum*, of which L.15,000 arises from the hereditary domains. Of this income from the domains, the forest forms two-fifths. The contingent of troops is 544 men; but there is no army, and the militia, in case of need, must form that part of the defence of Germany. The country is very mountainous, especially the Unterland, which displays scenery of the most beautiful and picturesque kind. The three course system of husbandry is generally followed; but, in many parts of the hills, it is too cold for wheat or even rye, and little besides oats is grown. Notwithstanding the growth of potatoes is very extensive, the duchy is compelled every year to draw supplies of corn from Bavaria. In spite of the general coldness of the country, in some of the sheltered deep vallies, grass comes to perfection, and wine is made. Flax, tobacco, and wood, are the principal productions. The latter is cut into those thin

Germany. plates used for sword-sheaths, backs of looking-glasses, and binding common books, which are distributed over the continent. Many toys for children are made, and some other wooden wares, which more than pay for what few commodities are wanted from other countries. The religion of the country is almost exclusively Lutheran, for there are no churches belonging to any other sect of Christians. A community of 600 Jews live by themselves in Unterland. It is divided into two portions. Unterland contains 180,480 acres, and 40,643 inhabitants; Oberland contains 68,480 acres, and 15,626 inhabitants. The only city is Meiningen, where the duke has a superb palace, and an open library of 24,000 volumes. The inhabitants of it are 4200.

Saxe Hildburghausen.

Saxe Hildburghausen, a small duchy, separated from the dominions of Saxe Coburg, and governed by a duke of a younger branch of that family. It lies upon and on the declivity of the Thuringian mountains. It does not grow all the corn it needs, though potatoes are much cultivated, and its stock of cattle is very small. It contains coal mines, rock salt, and salt springs. The religion is Lutheran, but there is one reformed church. The revenue is about L.20,000 Sterling, and its expences nearly equal. It has no regular troops. It contains 180,480 acres, and the inhabitants are 30,629. The city of Hildburghausen contains 3529 inhabitants, and Eisfeld 2414.

Mecklenburg-Strelitz.

Mecklenburg-Strelitz, a grand duchy. It is in some degree in the legislative bond with Mecklenburg-Schwerin, as the states of both duchies assemble together. The revenues are about L.45,000 Sterling, and the expenditure is nearly as much. The debts are very trifling. The troops are reduced to 136 men, and the contingent, of 717, must, if needed, be made up from the militia. The country is mostly sandy land, intermixed with lakes and woods. The three course rotation of husbandry prevails in some parts, but in others the convertible system is followed, and is extending. The principal productions are corn, potatoes, flax, hemp, hops, and wood. The manufactures are linen, and some woollen cloth. Almost the whole population is of the Lutheran confession; what few Catholics and Reformed there are, are supplied with occasional clergymen from Prussia, but they have no church. It is divided into two provinces, Strelitz and Ratzeburg. Strelitz is 423,000 acres, and contains 60,035 inhabitants; and Ratzeburg 107,520 acres, and contains 11,734 inhabitants. The cities are, New Strelitz, with 4525; New Brandenburgh, with 5145; and Old Strelitz, with 3031 inhabitants.

Lippe Ditmold.

Lippe Ditmold, a principality between the Prussian province of Westphalia and Hesse Cassel. The revenue is about L.48,000 Sterling, the expenditure nearly the same; the debt trifling; and the standing forces are reduced to a single battalion of 300 men. The country, though mountainous, is fruitful, and produces much corn, potatoes; and the forests yield much wood. The breeding and fattening of cattle is a large part of its husbandry. Flax is grown in large quantities, and making linen is the principal manufactory. The inhabitants are, 63,400 Reformed, 5100 Lutheran, and 600 Catholics. The extent is 277,120 acres. The cities are, Lemgo, with 3372, and Detmold, with 2370 inhabitants.

Schwartzburg-Sondershausen.

Schwartzburg-Sondershausen, a principality in the Thuringian mountains. Its revenues are estimated at L.20,000 Sterling annually, but are not very accurately known. It has no regular forces, but must supply its contingent of 451 from the militia. All the inhabitants are Lutherans, except a very few Catholics, and amount to 45,120. The extent of the land is 245,760 acres. It has two cities, Arnstadt, with 4300, aud Sonderhausen, with 3100 inhabitants.

Schwartzburg-Rudolstadt.

Schwartzburg-Rudolstadt, a principality adjoining to Sonderhausen. It is a fruitful country, rather hilly, not mountainous. It yields much corn, potatoes, flax, and cattle. It has some valuable mines of iron, lead, cobalt, and rock salt. The revenue is about L.25,000 yearly. The only regular force is a single company. The inhabitants, 53,940, are all of the Lutheran confession, except a few Catholics, who are found in the capital. The extent is 197,568 acres. The cities are, Rudolstadt, with 4100, and Frankenhausen, with 3000 inhabitants.

Anhalt-Dessau.

Anhalt-Dessau, a duchy on the left bank of the Elbe, and on both sides of the river Moldau. On the left bank of the latter river it is cultivated like a garden, and is highly productive, yielding good crops of corn, abundance of fruit, with rape-seed and oil, flax, madder, and tobacco. The only manufacture, that of linen, is very small. The revenue is about L.70,000 *per annum;* and the state has no debts. The military is nominally 600 men, but not more than an eighth of them are in service at the same time. The inhabitants are, 52,947, partly Lutherans, partly Reformed; the former have 21, the latter 32 churches. The Jews are about 1200. The extent is 232,320 acres. Dessau contains 9800 inhabitants; no other place has 2000.

Anhalt-Bernburg.

Anhalt-Bernburg, a duchy extending from the Elbe to the Hartz forest, and through which the Saale runs. One part of the territory is very productive of corn, the other portion abounds in mines of lead, iron, and coal, and has one silver mine, which produces annually about 5000 ounces of that metal. The inhabitants are 37,046, nearly equal in Lutherans and Reformed. The revenue is about L.45,000, the taxes low, and the regular army not more than 120 men. The extent is 219,568 acres. The cities and their inhabitants are, Bernburg, 4850; Wallenstedt, 2500; and Harzgerode, 2193.

Anhalt-Kothen.

Anhalt-Kothen, a duchy lying in four portions, on both sides the river Elbe. The whole is a level plain, with scarcely any elevated land. On the left bank of the river it is poor and sandy; on the right bank, productive in corn and flax. Some of the fields yield the greatest increase of any soils in Saxony. The income is about L.23,000 Sterling; but it is burdened with a heavy debt of L.140,000. Both are under a commission, who regulate the expences, and apply the savings to diminish the debt. It has no regular troops. The extent is 207,160 acres. The inhabitants are Lutherans and Reformed. The former have 19, the latter 28 parish priests. The only city is Kothen, which contains 5500 inhabitants.

Germany.

Reus.

Reus, younger branch, a principality divided into several districts, and much separated by the intervention of other states. It is generally an agricultural country, producing corn, potatoes, and flax. It breeds many sheep, the race of which has been improved by a mixture with those that yield the finer kinds of wool. There are some mines of iron. A considerable portion of cotton goods were manufactured, and some hosiery; the former has diminished much since the peace. The inhabitants are 52,205; the extent is 293,640 acres. The revenue is about L.23,000 Sterling. The national debt is liquidating fast, and does not amount to quite L.6000. It has no regular troops; but the militia, which is organized, must supply the contingent of 522 men, whenever they are required. The cities are, Gera, with 7373 inhabitants; Schleis (the capital), with 4620; and Lobenstein, with 2716.

Waldeck.

Waldeck, a principality surrounded by Prussia and Hanover. It is a very mountainous country, filled with mines, the geology of which is less known than that of any other part of Germany. The land is generally poor, and much encumbered with stones. Even in very fruitful years, it scarcely grows sufficient corn for its consumption, but must be supplied from the neighbouring states. Its poorer population subsist almost wholly on potatoes. In a beautiful valley, surrounded with lofty hills, the springs of Pyrmont rise, from which salts are made; and the place, in the summer, is crowded with visitors. The extent of the dominion is 293,970 acres; the inhabitants are 51,877; the revenue is about L.40,000 Sterling, but it is very deeply involved in debt. It has no regular troops, but a militia of 11,000 men, from whom the contingent of 518 must be supplied when wanted. The capital is Arolsen, a town of 1600 inhabitants. There is no city. Pyrmont has 1600 residents; but, in the season, has frequently from 2000 to 3000 who repair to the waters. From 300,000 to 350,000 bottles of the water are annually sent away.

Hohenzollern-Sigmaringen.

Hohenzollern-Sigmaringen, a duchy on the banks of the Danube, which runs through it. The country is generally poor, and produces little corn. The breeding of cattle is the principal husbandry. There are some iron mines, and some small manufactories of toys, yarn, potash, glass, and iron-ware. The extent is 293,120 acres; the inhabitants 37,032. They are all Catholics. The revenue is about L. 30,000 Sterling. It has no regular troops, but some militia: its contingent is 370 men. Sigmaringen, the capital, has only 777 inhabitants; all the other towns are small.

Hohenzollern-Hechingen.

Hohenzollern-Hechingen, a principality on the Swabian mountains. In the vallies, it is very fertile, and produces more corn than the consumption requires. The extent is 68,480 acres; the inhabitants are 14,500, all Catholics. The revenue is about L. 12,000 Sterling; the debt is annihilated, and the taxes are light. There are no troops, but militia; the contingent is 145 men. Hechingen, the capital, contains 2600 inhabitants.

Schauenburg-Lippe.

Schauenburg-Lippe, a beautiful principality between Minden and Hanover. It is very fertile and well cultivated. There are some valuable mines of coal in it, which are extensively worked. The extent is 138,880 acres. The inhabitants are 23,684, the greater part of whom are Lutherans; but in two of the towns, the Reformed is the prevailing party. The revenue is about L. 22,000 Sterling, which is principally derived from the sovereign domains. There is one company of regular troops in a small fortress on the Stein-huder lake. The capital, Bückeburg, has 2060 inhabitants, and another place, Stadthagen, 1461.

Reus-Plauen.

Reus, elder branch, or Reus-Plauen, a principality between Prussian Saxony, Saxe Gotha, and Saxe Weimar. It is fruitful in corn, and abounds with cattle. Iron mines are wrought, as those of silver, lead, and copper formerly were, though now abandoned. The extent is 95,360 acres; the inhabitants are 22 255, all of the Lutheran confession. The revenue is about L. 13,000 Sterling. There is no army. The capital city, Greiz, has 6195 inhabitants, and Zeulenrode 3615.

Hesse-Homburg.

Hesse-Homburg, a landgravate between the dominions of Hesse Cassel, Bavaria, and Prussia, in detached portions; some part of it is very mountainous, but the vallies are fruitful, producing corn, and very good wine. The extent is 84,480 acres. The inhabitants 20,000, equally Lutherans and Reformed; but there are a few Catholics and Jews. The revenue is about L. 20,000. There are no regular troops; the contingent is 200 men. The capital, Homburg, contains 2964 inhabitants, and Meisenheim 1730.

Liechtenstein.

Liechtenstein, a principality, and the smallest sovereign state in Europe. It is a beautiful small valley, between Switzerland, the Tyrol Mountains, and the Rhine. It is a highly picturesque country. The principal employment is cotton-spinning, and making various wooden toys. It contains 5465 inhabitants. The extent is 33,920 acres. The revenue L. 4500. Its contingent is 55 men. There is but one town, Badutz, in which is the palace of the prince, and the inhabitants are 1800. The Prince of Liechtenstein possesses estates within the Austrian territories, that are no part of his sovereignty, but which produce him a very large income.

Free Cities.

During the late war, all the free or imperial cities of Germany had been involved in the calamities that attended it, and were ultimately merged in the French empire. The Congress of Vienna has, however, resuscitated four of those cities, the only ones which were adapted for independence, and formed them into republican governments. They may thus become useful points of union betwixt the different states of Germany, and connect those states by commercial relations with the more distant portions of the globe.

Frankfort.

Frankfort on the Maine. This city has been declared by Congress the head of the free cities, for which, from its position, extent, and accommodations, it is well adapted. Having been formerly the seat of the imperial government of Germany, many of the princes of the empire had palaces within it, which have since been converted into hotels, or private dwellings, competent for the reception of the numerous diplomatists, and the concourse they attract, who must in future take up their residence in this city. Ambassadors from each of the states re-

Germany.

side in Frankfort; and, besides those of Germany, the other European potentates have envoys to transact their affairs with the general representatives of the country. Thus, Frankfort may now, in some measure, be considered as the metropolis of Germany. It is finely situated, has a navigable river, and a fertile district around it, and is one of the most magnificent looking cities on the Continent. Its power extends over two towns and six large villages. The government is an aristocracy founded on the amount of property; but the Jews, who are both rich and numerous, are not allowed to partake of it, or to live indiscriminately, but are all confined to a particular quarter. The trade of Frankfort is not considerable, nor are its manufactures, though numerous, extensive. A great many very large money transactions centre here; and it is one of the points from which the exchanges of the currency of many countries is very much influenced. The inhabitants are 47,850, including the whole territory. The Lutherans are the most numerous sect, and have gained possession of all the public offices. The churches are, seven Lutheran, three Catholic, and two Reformed; and the Jews, who are 10,000, have two synagogues. The revenues of the state are between L. 70,000 and L. 80,000 Sterling. The military force is one battalion of 300 men. The fortifications are levelled, and converted into most prolific gardens. Education is well provided for by schools of the higher order within the city, and parochial schools in all the villages. The whole extent of land, including the scite of the city, towns, and villages, is 65,480 acres, the greater part of which is admirably cultivated on the garden principle, and produces the best of fruits and culinary vegetables.

Hamburg.

Hamburg, the largest of the free cities, and, at one period, next to London, the greatest commercial city of Europe. Although it suffered most dreadful evils during the predominance of France, it has recovered in some degree from its depression, and is again a place of vast importance. The city contains 106,000 inhabitants; the whole territory, some towns of which are very distant from it, 129,850. The constitution is an aristocracy, founded on property; but the Jews are excluded from power, and restricted to residence in particular parts of the city. The whole government is by management, rather than by law, vested in the Lutherans, who form a very great majority of the inhabitants. The dissidents are 6000 Jews, 4000 Reformed, 2000 Catholics, and 500 Mennonites and Moravians. The commerce of Hamburg consists in the export of the productions of the various countries bordering on the Elbe, or the navigable streams that empty themselves into that river. Its imports comprise all those foreign luxuries which are furnished by the various countries of the globe, and which habit has rendered almost indispensable to many of the nations of Europe. It has some large public and private buildings, but all have a heaviness of appearance; and the streets are generally narrow and gloomy. In 1817, the number of ships that entered the port were 2320. The imports and exports are too various to be here enumerated. Vessels that draw more than fifteen feet water cannot come within the city, but must anchor in the stream. The whole extent of the territory, including the scite of the city and towns, is 83,840 acres; that portion of the land that is not in gardens is sandy and poor. The revenue amounts to about L. 100,000 Sterling. The public debt was large, nearly L. 5,000,000, incurred when under the French; but a portion since the peace of 1815, has been diminished by the contribution which France was compelled to pay. The regular military are 1450 men. The other towns are, Bergedorf with 2000, and Ritzebüttel, with Cruxhaven, 1819 inhabitants.

Bremen.

Bremen, an ancient city, with a small territory round it. The city contains 36,630 inhabitants, the rest of the dominion 11,900. The constitution is of a democratic kind, and the magistrates are changed every six months. Its situation on the banks of the Weser is favourable for foreign trade, and for transmitting and receiving productions that descend from the point at Minden, where that river ceases to be navigable. The greater part of the inhabitants are of the Reformed sect, and have four churches; all the magistrates must be of that confession. The Lutherans have one church. The revenue is about L. 40,000 Sterling, and exceeds the expenditure. The surplus is applied to the liquidation of the state debt, the amount of which is not made public. The military force is only militia, the contingent 385 men. The other towns are Vegesack, with 1534, and Borgefeldt, with 1417 inhabitants.

Lübeck.

Lübeck, a free city, with a small territory around it on the river Trave, which runs into the Baltic Sea. In former periods it was the head of the Hanseatic League, and, in that capacity, with its powerful fleets, was enabled to give law to the powers on the shores of the Baltic. It is now much reduced, having within the city only 29,060 inhabitants, and in the surrounding dependencies 11,590. The religion is Lutheran, but the Reformed have a church, though without the walls. The Jews are forbidden to live within the city, and reside at the village of Israelsdorf. It has some trade, and possesses between eighty and ninety ships. The income of the state is about L. 37,500 Sterling, and its debts are heavy. The only military are the militia. The extent of territory is 96,000 acres. The other towns are Travemunde, with 941, and Genen with 609 inhabitants.

Recent History.

As the events which produced the deliverance of Germany from the yoke of France belong to the history of that country as much as to this, our notices of it here must be brief. After the destruction of that vast army which penetrated into Russia, almost all the states of the north of Germany, with Prussia at their head, declared war against France. An army was quickly collected from the French conscription, and, with a wonderful celerity, Bonaparte at its head, was enabled to penetrate into Saxony, to threaten Prussia, and exhibit a force which he supposed would overawe Austria. The battles of Lutzen and Dresden, in 1813, produced an armistice, during whose continuance, negotiations for peace between Russia and Prussia on one side, and France on the other, were carried on under the mediation of the Emperor of Austria. As peace could

Germany || Glamorganshire.

not be concluded, Austria was induced to join the allies against France. During these periods, a spirit had risen in Germany which animated all classes of its inhabitants, so that those powers which still clung to the interests of France, could place no reliance on the support of their subjects. Bonaparte, overpowered by numbers, with an army of raw troops from his own dominions, and with troops of doubtful fidelity from the dominions of his allies, was surrounded, and, after being compelled to retreat from Dresden, fought the important battle of Leipsic against the armies of Russia, Austria, Prussia, and Sweden. The issue of that battle was not considered to be doubtful from its commencement, but, during the contest, the Saxon division of the army marched from their station in the French line, and took up their position with the Prussians. The result of the battle was a hurried retreat from Leipsic to the frontier of France, which was then the river Rhine. On the retreat to the Rhine, the shattered remains of the French army were interrupted by the forces of Bavaria. A battle was fought at Hanau, about twelve miles from Frankfort, which, though gained by the French, tended only to hasten their flight, and to the loss of much that remained of their stores, arms, and ammunition.

By the end of the year 1813, the French were totally expelled from every part of Germany, and the occupation of Paris by the allies, early in 1814, led to general tranquillity. The Congress of Vienna soon after met, and never was a body of plenipotentiaries plunged into such a labyrinth of difficulties. The great extent of country that had been delivered, and was without any government, the number of claims urged either from previous possession, or from active service in effecting the deliverance, were such as to perplex with difficulties that appeared to be nearly insuperable, and, in whatever way they were terminated, must necessarily leave great dissatisfaction. They were, however, so settled as to leave Germany in the state described in the preceding pages, and whether they could have been adjusted with more regard to the principles of equity is not for us to decide.

The return of Bonaparte from Elba produced most gigantic efforts on the part of all those smaller sovereigns who had been reinstated in their dominions by his downfall. The number of troops actually mustered and prepared to march when the battle of Waterloo took place and suspended them, amounted to more than 1,200,000 men. They were not indeed all armed, but many more men could have been raised if arms for them could have been procured. These efforts, added to the costly exertions made in the war of the deliverance, have encumbered with debts almost every state, as is noticed in the detailed account of them. These debts, however, have not been solely created by those events. The ephemeral kingdom of Westphalia, formed for Jerome Bonaparte, extended over Hanover, Brunswick, and Cassel, as well as the circle from which it was denominated. During his government, all the different portions of his kingdom had incurred vast debts in executing his projects. These debts were owing to individuals or corporate bodies within the dominions attached by the Congress to their new sovereigns, and those princes, for the sake of the people, were compelled to assume the debts and provide means for their liquidation, and the payment in the meantime of the interest. Thus the ungrateful task of providing for the expenditure attending the subjection of their states, as well as for their liberation, has become one of the first duties on their resumption of power. This odious consequence of former circumstances has been industriously improved by the enemies of tranquillity, and has created considerable discontent. It has indeed been attended with no violence, and recently the people have appeared to be convinced that the taxes which are imposed are necessarily owing to circumstances over which their rulers had no control.

The best account of the present state of Germany is the large work produced from the joint labours of Gaspari, Hassel, Cannabich, and Gutsmuth, printed at Weimar, 1819; but every state, besides, has its local history, description, and statistics, which will not admit of enumeration in this place. Many of the preceding statements were collected by the compiler of this article, from various sources, whilst recently in Germany.

(W.W.)

GLAMORGANSHIRE, a county of South Wales, stretching, in a circular line, along the northern shore of the Bristol Channel, from east to west about 42 miles, and extending to the mountains in some parts to the distance of 22 or 23 miles. It is bounded on the north by Caermarthen and Brecknock, on the east by Monmouthshire, and the south and west by the Bristol Channel. Its whole area is 822 miles, or 526,080 statute acres, in which is included the water-courses, roads, and scites of buildings, which occupy a large surface.

Boundaries.

Divisions.

The county may be divided into two districts of a very opposite character, according to the nature of the soil, rather than into those ten hundreds by which its parts are politically denominated. About one-half the county, on the sea-shore, is rich and fertile land, and produces excellent crops of wheat, oats, beans, and barley. The soil is generally of moderate consistence, of a loamy nature, some parts mixed with clay, some with sand, but almost all resting on a calcareous substratum. It is easily ploughed, very friable, and, when laid down to grass, yields excellent herbage, by which many cattle are fattened, and much good butter is made. The manure principally used is lime, which can be rendered very cheap from the vicinity of coals to the limestone district.

Surface, Soil, and Agriculture.

The inland part of the county rises gradually from hills to mountains, and, in that district, the agriculture is in a very backward state. The soil between these hills and mountains is composed generally of a black peat, but sometimes of a brown gravelly earth;

Glamorganshire. lime applied to the former is beneficial for a few years, but its good effect ceases, and having but little cattle to make manure, and that manure being neglected to be preserved with due care, the agricultural produce of the district is insufficient for the subsistence of the inhabitants. On some of the mountain farms the land is sowed with corn as long as it will yield any increase without fallow or manure, and when so far exhausted it is left without cultivation for many years. Much of the uninclosed mountain tract is devoted wholly to feeding sheep, and the occupiers of land around them having rights of common without stint, so overstock, that the animals seldom attain their full growth; but when removed to better pasture, and fattened, their mutton is excellent. The farms are mostly of very small value, varying in rent from L. 5 to L. 200 annually; the average of the whole is not L. 50, though in many instances the rent has been tripled, and even quadrupled, within the last twenty years. The ploughing is generally executed by oxen, and their ploughs being of clumsy contruction, sometimes six or eight are used to perform the work, and yet perform it ill; in some cases two, in others four, are harnessed to the plough with two horses before them. The most commendable part of the rural economy of the county is the construction of the houses, barns, and other farming erections. These are solidly and substantially built, and being uniformly white-washed on the outside, have a clean and neat appearance.

Minerals. The agriculture of this county, valuable as it is in the more southern part, is the least productive source of its riches. The greater part of it abounds with minerals, which, owing to the great extension of good roads, of navigable canals and railways, within the last few years, have become a most important source of wealth. The northern and middle parts of the county comprise a portion of that great mineral tract, which begins at Pontypool in Monmouthshire, and terminates at St Bride's Bay in Pembrokeshire. The exterior stratum or boundary is a bed of limestone, within which are contained all the strata of the other minerals in the following position. On the north side of a line, drawn from east to west through the middle of the district, all the strata rise gradually to the north, and on the south side of the same line they rise to the south till they come to the surface, except at the east end, where they rise to the eastward. In the centre of this tract the iron and coal mines in the vicinity of Myrthr-Tydvil are both the richest and most abundant. The whole of the coal is at the depth of 440 feet beneath the surface of the ground, which is composed of argillaceous strata, with occasional veins of hard rock. The coal is about 52 feet deep, the thickness of the veins varying from 12 inches to 9 feet in thickness. The iron stone lies under the stone for about 108 feet, and is separated by argillaceous earth and stone into eighteen different veins, each about 4 feet 10 inches in thickness. When this ore is smelted, it yields iron to the amount of three-tenths of the weight of the ore.

Coal is found in vast quantities both on the north and south divisions of the county, but of different natures. That on the south is of the bituminous kind or coaking coal, like the coals of Newcastle. That of the north (when large, called stone-coal and small culm) is difficult to kindle, burns slowly, but emits an intense heat with little or no smoke, and without being distended. This latter is principally used by the maltsters and lime-burners.

Although the abundance and excellence of the coal and iron have caused the erection of blast furnaces in many parts of the county, yet the largest and most numerous are those near the recently-built town of Myrthr-Tydvil, which, within a few years, has grown up from an obscure village to the most populous place in the whole principality of Wales, and contained, in 1811, 11,000 inhabitants.

Iron-works. There are seventeen blast-furnaces near this place, each of which can make from 50 to 100 tons of iron weekly. The most extensive of the works, that of Cyfartha, belonging to Messrs Crawshay and Company, produce annually 11,000 tons of pig iron, and 12,000 tons of bar iron. The fires of the furnaces are blown by a steam-engine of 50 horse power, and an overshot wheel of 50 feet in diameter, which requires 25 tons of water each minute to keep it at work. The number of men employed at Messrs Crawshay's work is from 1500 to 2000, making, with their families, more than 4000 persons, whose wages amount to between L.70,000 and L.80,000 annually.

The next considerable manufactory is that commonly called tin plates. The cheapness of iron and coal causes the tin of Cornwall to be sent here, and spread over those iron plates, which are afterwards dispersed over all the world.

In like manner, the copper ore from Cornwall, from North Wales, and from Ireland, is attracted to Glamorganshire by the cheapness of coal; and it is smelted in works upon a most extensive scale, in the vicinity of Aberavon, Neath, and Swansea, from whence it is forwarded by water-carriage to the places where it receives its final appropriations to the several purposes for which it is wanted. There are some extensive manufactories of earthenware, which are increasing in their operations, and small concerns adapted for making soap, salt, and woollen cloths.

Trade. The most considerable exported production from this county is coals from the ports of Swansea and Neath. At the former of these ports, the facility of loading vessels is so great, that ships of three hundred tons burden enter with one tide, are loaded and enabled to sail sometimes the next, but usually the next tide but one. The quantity annually exported has amounted to 300,000 tons, and more might be shipped, but for some superior privileges in the city of Bristol, which favour the coal mines of Monmouthshire and Gloucestershire.

Rivers. The rivers of Glamorganshire are, *1st,* The Taf or Tave, over which is the celebrated bridge of one arch, supposed to be the largest in the world, being one hundred and forty feet in the span, planned and executed by an untaught country mason, a native of the county. *2d,* The Elay, a stream of short course, near Llantrissent. *3d,* The Ogmore, crossing the county, and entering the sea near Bridgend. *4th,* The Nedd or Neath, passing from Brecknockshire, through most romantic vallies, by Neath to the sea at Britton Ferry; and, *5th,* The Tawy, which discharges itself into Swansea Bay.

Glamorganshire. Canals.

As these rivers are scarcely navigable, and those two that are so, but for a short distance, canals have been constructed for the conveyance of the heavy productions of the county, which have produced a wonderful effect both on its wealth and population. These are the Cardiff canal, which affords water carriage from Myrthr-Tydvil to Penarth Bay; the Neath canal, which traverses the county from south to north; and the Swansea canal, which runs to the north till it reaches Brecknockshire. The number of rail-roads communicating between the iron-works and coal-mines and the canals are too numerous to admit of recapitulation, and have proved very beneficial undertakings both to the constructors of them and to the public.

Language.

The peasantry of this county generally use the Welsh language, and either cannot or will not speak English. In the towns, however, the latter is very commonly spoken, and in the churches the service is occasionally conducted in it. There is, however, a portion of the county, to the south of the mountains round Oxwich Bay, where the Welsh language is quite unknown, whilst, on the opposite side of the same mountains, the inhabitants are unacquainted with English.

Population.

Two members are returned to Parliament from Glamorganshire, one for the county, and one for the boroughs of Cardiff, Caerphilli, Myrthr-Tydvil, Cowbridge, Llantrissent, Bridgend, Aberavon, Neath, and Swansea. By the returns under the population act, the inhabitants, in 1801, were 71,525, and, in 1811, were 85,067, besides the militiamen, their wives, and families, making together about 86,000. At the last enumeration, the males were 41,365, and the females 43,702.

Gentlemen's Seats.

As the picturesque beauty of many parts of the county is very great, it has ever been the favourite resort of many families of respectability. That it was so in ancient times, the number of ruins of ancient castles clearly evince; and few parts of the island, except the immediate vicinity of the metropolis, have so many gentlemen's seats within them. The principal of these are, Gnoll Castle, the seat of the Mackworths, now Mr Grant; Cardiff Castle, Marquis of Bute; Dunraven, Thomas Wyndham, Esq.; Penlline Castle, Lord Vernon; Margram, Mr Talbot; Classmont, Sir John Morris; Southall, John Lucas, Esq.; Gellyhir, Sir Gabriel Powell; Penllergaer, John Llewelyn, Esq.; Penrice Castle, R. M. Talbot, Esq.; Woodlands, General Ward; and Penderi, Thomas Morgan, Esq. with many others.

Towns.

The principal towns in the county are Cardiff, which, though not the largest, is the county town, and the shipping place of the produce of Myrthr-Tydvil. Its pier is accessible to ships of 200 tons burden. The inhabitants, in the year 1811, were 2457, viz. 1084 males, and 1373 females. Llandaff, though a city, is reduced to a small assemblage of mean houses, and 960 inhabitants; and remarkable for nothing but the cathedral, the ancient part of which is in ruins, within which a new and commodious one of smaller dimensions was erected in 1751. Neath, a place of considerable trade, contained at the last census 2740 inhabitants; its environs are peculiarly beautiful. Swansea contained 8196 inhabitants; and besides the stationary people, great numbers flock to it in summer for the enjoyment of sea-bathing, for which it is conveniently situated.

Glamorganshire || Glasgow.

See Rees's *South Wales;* Malkin's *Scenery of South Wales; Parliamentary Returns of Population for* 1811. (W. W.)

GLASGOW. The *Encyclopædia* contains an account of the city of Glasgow, and of its various establishments; but, since that article was written, this city has made a great advance in wealth and population; and we propose to lay before our readers a short view of this progress, and of the change which has taken place in its manufactures, commerce, and public institutions, from that time.

Cotton Manufacture.

The cotton manufacture, now the great staple of Glasgow, was, at the period we allude to, in its infancy. The inventions and improvements in the processes of cotton-spinning which Hargreaves, Arkwright, Crompton, and Kelly, had, a short time before, successively brought forward, had furnished the means of producing, in Britain, the cotton goods which till then had been exclusively supplied by India. The people of Glasgow had found the manufacturing of these articles very profitable; and, about the year 1786, had begun to abandon the manufacture of cambrics, lawns, gauzes, and the other light fabrics of linen, which had grown up there in the course of the century; and, before the year 1792, the making of these goods had been nearly superseded by the manufacture of cotton.

We shall not here enter into a detail of the unprecedented rapidity of the growth of this new branch of trade, the particulars of which, with an account of the different descriptions of cotton goods which are produced at Glasgow, have been given at length in another part of this work. (See the article COTTON MANUFACTURE.) But to mark, in some degree, its extraordinary progress in this city, we may mention, that, at the period of its commencement, the annual value of the whole manufactures of Glasgow was not estimated at above L.800,000; and, in the year 1818, about thirty-two years after its introduction, it was computed that 105,000,000 yards of cotton cloth, valued at L.5,200,000, were manufactured in Glasgow, and between 13,000,000 and 14,000,000 pounds of cotton wool used in their production.

In the spinning department of this manufacture, there are now fifty-four mills employed, containing nearly 600,000 spindles; and the capital invested in the buildings and machinery, for carrying on this branch, is estimated at above L.1,000,000 Sterling. For weaving the yarn, there are 2800 looms, moved by mechanical power, producing weekly about 8400 pieces of cloth; and there are, as nearly as can be ascertained, 32,000 hand-looms.

Calico Printing.

The calico printing business, begun here about the year 1742, stands next in importance to the cotton manufacture. There are eighteen calico printing works belonging to Glasgow, some of them of great extent; but there has not, for some time, been the same amount of business carried on by these concerns as was formerly the case; owing partly to the change which has taken place in the dress of the

Glasgow. people, and partly to the circumstances affecting the general trade of the country, afterwards to be noticed.

Calendering. As one of the appendages of the extensive manufacture of cotton, and other piece goods at Glasgow, we have to notice that there are, in this city, fourteen calender and five lapping houses, containing twenty-seven calenders, moved by steam, and eight moved by horses, which frequently calender 268,000 yards of cloth in a day, besides glazing 38,400 yards, and dressing 552,000 yards.

The manufacture of stockings, and that of shoes for exportation, both at one time considerable, have gradually dwindled away, other more profitable manufactures having carried off the capital and labour which had found employment in them.

Machine Making. The extensive use of mechanical power in our manufactures has given rise to a business in Glasgow in which a considerable capital is now engaged—the making and constructing of steam-engines, and of the different machines used in manufactories. But, besides the employment afforded to this branch by the manufactures of this country, a number of steam-engines and sugar-mills are now sent from Glasgow every year to our sugar colonies; and a new field of employment has lately been opened to the machine-makers, in preparing machinery for vessels to be navigated by steam. It has become a considerable branch of the ship-building business of the Clyde to construct steam-vessels for other navigations, the hulls of which are built at the docks of Greenock and Port-Glasgow, and the vessels afterwards brought to Glasgow to be fitted with their machinery. We may state here, although the remark more properly belongs to another part of our subject, that this new conveyance, which forms so valuable an addition to our means of local intercourse, was first introduced on the Clyde in the year 1812; and that there are now 28 steam vessels plying on the river, and sailing to different towns on the west coast, as far as Liverpool.

Commission Business. In the early period of the manufactures of Glasgow, the goods were chiefly disposed of to the Virginia merchants of the place; and a few were sold to wholesale dealers in London, and to a class of traders in Glasgow who attended the different large English fairs. But, towards the end of the American war, when the enterprise and capital of the people began to take a stronger direction towards manufactures, those engaged in them sent out travellers to every part of Scotland and England, to make sales of their goods, and extended their dealings even to the Continent. In the year 1787, for the first time, some persons connected with Glasgow opened a commission-house in London for the sale of manufactured goods, on account of the manufacturer; and, about ten years afterwards, similar establishments were formed in Glasgow, and in the other large commercial towns of Great Britain. About the year 1802, commission-houses on this plan were opened at Kingston, in Jamaica; and, within the last few years, these establishments have been extended to every place where a sale of British manufactures to any great amount is to be found. The facilities which these houses of sale afford to the manufacturers, by the advances of money on the goods consigned to them, have had the effect of encouraging over-trading to a very great degree; and have been the means also of bringing into, and supporting in the business persons without capital, who are often obliged to ship off their goods merely to procure funds. The markets have been thus kept so constantly overstocked, that, for some years, it is believed, little or no profits have been obtained.

Recent Depression of Manufactures. In noticing the manufactures of Glasgow, we cannot but advert to their retrograding state since the year 1815, arising from a decrease in the demand for their products;—a calamity, to which, indeed, the whole productive industry of the country, during this period, has been subjected. This situation of our affairs has been attributed to our having lost, at the peace, the monopoly of manufacturing for Europe, which we were said to have enjoyed during the war; but we cannot think this circumstance, supposing it to have existed to a degree much greater than could possibly be the case, would, in any satisfactory manner, account for the severe depression of our present situation. The evil, we apprehend, lies much deeper, and is of a much more serious nature. The diminution in the demand for our goods on the Continent, we are satisfied, arises from a different cause than the want of this supposed monopoly, and is produced by the impolitic commercial regulations of this country narrowing our foreign intercourse. Our system is to raise every thing within ourselves, and we expect, notwithstanding, that other nations shall continue to take our products, and find the means of paying us for them. This is in its nature impossible. Our commodities can be paid for only by commodities, and the sales of our goods to other nations can never exceed the means we possess of consuming *their* products. If, from any cause, our people become disabled, or are prevented, from purchasing the quantity of foreign commodities which they formerly did, a corresponding diminution of the sale of our own productions must be the consequence.

We believe, therefore, that it is the joint operation of these two circumstances, the prevention, and the disability to purchase, which is the cause of the progressive reduction of sales which has taken place in our market. Forbidding the importation of commodities with which other nations are able to furnish us cheaper than we can produce them ourselves, and in exchange for which an additional quantity of the commodities we can advantageously raise would be required, not only injures our commerce, but imposes a tax on the general income. The other circumstance in our situation, the disability to purchase, we fear is operating against the market with still more alarming effect. It does not belong to this article to go deeply into any inquiry on this head. But there can be no question that the middling and lower classes of our population no longer possess the means of purchasing the quantity of our manufactures, or of the foreign products received in exchange for them, which they formerly were accustomed to use. And we do not think that

Glasgow.

we need to look abroad for the cause of this change; for, while our people are taxed for the maintenance of the State, to the amount of at least a third part of their earnings, and obliged to pay afterwards for every article of food they consume nearly double the price paid by the foreign manufacturer, whose powers of competition must regulate the wages to be received by our labourers, and the profit to be got by the employer, there can be no doubt but that the means of the country to purchase either manufactured goods, or foreign commodities, are abridged.

The operation of these causes, since the year 1815, upon the trade and manufactures of Glasgow, previously fostered into an unnatural state of prosperity, by the extraordinary circumstances of the war, has occasioned a degree of embarrassment and distress, which is unparalleled in the commercial history of this country.

Trade with America.

The article in the *Encyclopædia* contains a particular account of the extensive trade which Glasgow carried on with Virginia before the American war;—a trade which was supported by the circumstance of France receiving, through the medium of the Glasgow merchants, a great part of the tobacco she consumed. But the establishment of American independence having enabled the French to import directly from that country, the intercourse of Glasgow with Virginia was reduced to a trade of very small amount. This loss, although alarming at the time, was soon considered to have been of no material injury to the interests of the place. The business had been confined to a few houses; the quantity of goods exported in return for the tobacco had never been large; and the returns, owing to the extension of credit to the planters, had been very slow. The traders of Glasgow, therefore, began to turn their views to the better peopled States of the Union, and to Canada, as likely to furnish a more extensive market for the sale of those manufactures, to which the capital and industry of the town had now become strongly directed.

Some of the manufacturers of Glasgow having, at different times, carried to the United States small assortments of their goods, and found there a ready market for them, began, about the year 1793, to establish houses in the principal towns, for the regular disposal of their commodities, and for shipping home the returns received in exchange for them. These establishments increased with the increasing demands of the two countries for each other's products, and a valuable commercial connection in this way gradually grew up between them. The manufacturers who had begun this trade in the view of opening a market for their own particular articles, were led afterwards to improve their assortment, by adding to it other manufactured goods which they purchased; and finding this part of the business to be more important than the other, and to require all the capital they could command, they withdrew from manufacturing, and became wholly merchants.

The plan upon which this business has been since conducted, as well as that of the establishments, formed afterwards for similar purposes, in the West Indies and in the States of South America, is calculated to give stability to the trade, and, at the same time, to lead to its extension. The transactions of these houses are managed by a partner residing on the spot, assisted by young men sent out from time to time to serve under him in the capacity of storekeepers and clerks. This partner pays occasional visits to this country, to give directions in the selection of the goods; and, after some time, returns finally to settle at home and take charge of the business, leaving in his place one of those young men, who is then assumed as a partner. The others, when they do not meet with a like opening, seek for themselves connections with other parties, and lay the foundation of new concerns.

Establishments of this description have been formed by the merchants of Glasgow in all the principal towns of the United States, in Canada, in Nova Scotia, in the West Indies, in the Brazils, and in the principal towns of the South American States.

We have mentioned the commission-houses of Glasgow, opened in our different foreign settlements, for the sale of manufactures; and that these establishments had of late years greatly increased. Wherever this has taken place to any great degree, the merchants we have now been describing have been obliged, one after another, to retire from the business, finding it impossible to sell, with a profit, the goods they had purchased, in competition with the same articles poured into the market by the manufacturers themselves. Many of these parties, however, unwilling to quit the ground they had so long occupied, and looking forward to a change necessarily to take place in this ruinous mode of carrying on the trade, have, in the view of keeping up their establishments in the meantime, converted them into commission-houses.

West India Trade.

About the end of the seventeenth century several sugar refining houses had been established in Glasgow; the raw sugars for which were brought from Bristol and London. But as soon as the union of the kingdoms had opened to the Scots the trade to the Colonies, the merchants of Glasgow became desirous to obtain their supplies of this article directly from the West Indies, and sent out vessels from time to time with herrings and other articles, and brought back sugars in return. It was not, however, till about the year 1732, that any fixed connection was attempted to be formed with the islands, for supplying the estates of the planters with necessaries, and receiving in return the consignment of their crops. This branch of the West India business, which is distinct from that of supplying these countries with manufactured goods, and carried on by a separate class of merchants, commenced in Glasgow at this period. It was confined for some time to a few houses, and its growth was slow; the market for West India commodities being limited to the consumption of the surrounding district, and to occasional sales of small parcels of sugar and rum to Ireland. In the year 1775, the imports of West Indian produce into the Clyde were as follows:—sugar, 4621 hhds. and 691 tierces; rum, 1154 puncheons and 193 hhds.; cotton, 503 bags.

But in proportion as the wealth and population of

Glasgow.

this part of the country increased, and with these the means of consuming West India commodities, the traffic which the merchants of Glasgow carried on with the planters increased also.

The war of 1793 having given to Britain the colonies of the other European states, and, for a time, the exclusive access to the markets in which their products were to be sold, the merchants of Glasgow availed themselves of their favourable situation for carrying on this trade, and got possession of a large share of the business. In this commerce considerable fortunes were made, and Glasgow having become a more known and established medium for supplying West India commodities to the Continent, an extension of her general West India trade has been the effect. This will probably continue after the monopoly from the temporary possession of the foreign colonies has been done away. The imports of West India products into the Clyde, for the years 1812, 1813, 1814, and 1819, were as follows:

Sugars.	1812.	1813.	1814.	1819.
Hogsheads,	28,862	36,037	40,004	24,256
Tierces, -	2,543	4,038	3,712	1,142
Barrels, -	5,868	7,248	6,282	1,368
Boxes, -	100	2,660	8,703	bags, 4,603
Rum.—Jamaica.				
Puncheons,	2,346	5,265	4,030	3,645
Hogsheads, -	53	141	150	279
Leeward Islands.				
Puncheons, -	4,690	7,567	7,410	1,651
Hogsheads, -	44	23	69	110
Coffee.				
Casks, -	5,025	12,325	16,251	3,240
Barrels, -	928	5,384	8,107	575
Bags, -	7,927	35,823	53,237	9,148

East India Trade.

Soon after Parliament had laid open the trade to the countries lying to the east of the Cape of Good Hope, Glasgow entered largely into the business. This new branch, when freed, as it must soon be, from every remaining restriction, promises to be one of the most important we have ever possessed. It is impossible, indeed, to form even a conjecture of what may be the results to our commerce, and the spring to our industry, from a free intercourse with the countries lying around the Indian seas—rich in natural productions and works of art, and containing a population of more than four hundred millions. Already we have found in these countries a growing sale for our manufactures, and, what is most extraordinary, for our muslins and other cotton goods. Such is the power of our mechanical contrivances, it would appear, that we are enabled to bring the cotton wool from India, to work it up here, and sell the cloth again in that country, at a price below that at which the natives, with all the advantages of cheap labour, and unexampled manual skill, can produce it.

The foreign commerce of Glasgow for the last few years has suffered, no less than her manufactures, from the want of market, and proceeding from the same cause—the disability of the country to purchase and consume the commodities imported.

Extension of the City.

The extension of the town, and the increase of the population of Glasgow, within the last forty years, is almost unexampled. The whole of what is called the New Town, the extensive suburbs on the south side of the river, called Lauriestown, Hutchisontown, and Trades' Town, and almost the whole of the large and very populous suburbs of Calton and Bridgeton, have been built within that period. During the same time, too, the following public buildings have been erected, which, independently of the particular purposes to which they are applicable, have contributed to the ornament and beauty of the city:

The Royal Infirmary, the Trades' Hall, and the Assembly and Concert Rooms, from designs furnished by Messrs Robert and James Adam.

Hutchison's Hospital, the Theatre, and St John's Church, from designs by Mr David Hamilton.

The Hunterian Museum, St George's Church, the Court-Houses and Prison, and the Lunatic Asylum, from designs by Mr William Stark.

The Roman Catholic Chapel, from a design by Mr James Gillespie.

Besides these public buildings for useful purposes, an Obelisk, 142 feet high, was, in 1806, erected to the memory of Lord Nelson.

University and other similar Institutions.

Since the publication of the former article, several alterations have taken place in the state of the University. The Hunterian Museum, bequeathed to it by the late Dr William Hunter, an acquisition of great value and importance, has been moved to Glasgow. A Professorship in Natural History has been instituted, and the former Lectureships in Chemistry, Botany, Midwifery, and Surgery, have been converted into Professorships. Since the building of the Infirmary, the College of Glasgow has been regularly rising into name as a medical seminary, and the number of medical students yearly increasing. Indeed, the increase of students in all the classes has been great, and has kept pace with the increase of the town. The number at the time our former article was written was 500, and, in the last session (1819-20), it had risen to 1264.

Besides the additional provisions for instruction which have taken place in the University, several institutions for education and the advancement of knowledge have been founded.

In the Andersonian Institution, founded by the late Professor Anderson in 1795, in which popular lectures upon Natural Philosophy, upon Chemistry, upon Mechanics, * and upon Anatomy, are given. An Astronomical Society has been formed, an Observatory built on Garnet Hill, and a very valuable collection of instruments purchased. A Botanic Garden, in the immediate neighbourhood of the town, containing six acres of ground, has been laid out; the expence of which is defrayed by private subscription, along with a contribution from the funds of the university. Three public libraries have been founded,—Stirling's Library, the Robertsonian

* An account of the Lectures upon Mechanics will be found in our Article on the COTTON MANUFACTURE.

Glasgow.

Library, and the Glasgow Public Library. The first was an endowment by the late Mr Walter Stirling, and has a revenue, including contributions, of about L. 200 a year. As some further criterion of the disposition for information in the inhabitants of Glasgow at the present period, it may be proper to note, that there are above forty booksellers' shops in the town, and that nine newspapers are published every week.

Police.

The Police Establishment of Glasgow, for watching, lighting, and cleaning the streets, is extremely well adapted to its end, and conducted with great economy, the whole expence being defrayed from a tax of 5 *per cent.* on the house rents. The management is vested in the Magistrates, and twenty-four Commissioners chosen by the inhabitants by ballot. " These Commissioners hold stated weekly and quarterly boards, while numerous committees watch over the particular concerns of every department." The executive body acting under them consists of a Master of Police, nineteen officers, eighty watchmen, twenty patrole, and sixteen scavengers.

There is a separate Police establishment, with a board of Commissioners, a Master of Police, and complement of officers and watchmen, for the suburbs of Gorbals, Laurieston, &c. lying on the south side of the river.

Population.

The following is a view of the progressive population of Glasgow, from the earliest time we have any account of the number of its inhabitants:

In the year	1560 their numbers amounted to	4500
. . .	1610	7644
. . .	1660	14678
. . .	1688	11948
. . .	1708	12766
. .	1712	13832
. . .	1740	17034
. . .	1755	23536
. . .	1763	28300
. . .	1780	42832
. . .	1785	45889
. . .	1791	66578
. . .	1801	83769
. . .	1811	110460
. .	1820	147197*

A view of the progress of Glasgow from time to time may be afforded, from a statement of some other circumstances connected with its situation, which will serve to mark, in some degree, the state of its inhabitants at these periods.

The rental of the houses, and of the places of business within the royalty, was,

In 1712,	L. 7,840	In 1810,	L.194,753
1773,	36,706	1815,	240,232
1803,	81,484	1820,	286,340 †

The following taxes were levied on the inhabitants living within the royalty:

	Property and Income Tax.				Assessed Taxes.		
In 1806-7,	L. 56093	8	0	.	L.20643	1	5½
1810-11,	56775	15	3	.	22964	18	3
1815-16,	66735	8	6	.	31180	12	10½
1819-20,	00000	0	0	.	30585	5	10½ ‡

Fund for Paupers.

The sum raised in Glasgow for the maintenance of the poor is assessed upon the supposed property and income of the inhabitants residing within the royalty, and the valuation of these is made up by a jury of fifteen citizens, appointed annually. Property belonging to an inhabitant, if lying out of the royalty, is not included in the sum to be assessed; and the amount of each individual's estimated wealth or income is taken below what is thought to be its real value; the attention of the assessors being principally directed to maintain the relative proportions to be paid by the parties. No person whose valued property is under L. 300 is included in the assessment.

The assessment for the poor in			*per* L. 100	
1785 was	L. 1,092,	levied on L.2,096,600,	at 1s.	2½d.
1795 .	3,387,	. 2,540,200,	. 2	8
1805 .	5,265,	. 4,357,250,	. 2	5
1815 .	9,940,	. 6,447,900,	. 3	1
1820 .	13,120,	. 6,174,400,	. 4	3 §

There is, in the information given in this table, matter for the consideration of the political economist. From 1785 to 1820, the assessment for the poor advanced from L. 1092 to L. 13,120, and the rate, notwithstanding the increase of the wealth of the town within that period, from 1s. 2½d. to 4s. 3d. *per* L. 100. And, it is to be observed, that the great proportion of the increase of the population of Glasgow, which took place within this time, as shown in the population tables, was in those parts of the town lying without the royalty, the poor of which receive nothing from this fund.

The assessment of 1819 and 1820, amounting to L. 13,120, was levied from 2759 persons, whose assessable property was valued at L. 6,174,400. We give the particulars of this assessment, as an important document in an account of Glasgow, to show in what proportions the valued wealth of the inhabitants, living within the royalty at the time, was distributed among them.

* See *Enumeration of the Inhabitants of Glasgow, with Statistical Tables*, by James Cleland, Superintendent of Public Works for the City. Printed for the Magistrates in 1820.

† Ibid.

‡ Ibid.

§ Ibid.

Persons Assessed.	Sum Assessed on.	Persons Assessed.	Sum Assessed on.	Persons Assessed.	Sum Assessed on.	Persons Assessed.	Sum Assessed on.	Persons Assessed.	Sum Assessed on.
771	L. 300	1	L. 1600	2	L. 5500	7	L. 13,000	1	L. 26,000
3	400	1	1800	62	6000	8	14,000	1	28,000
43	500	208	2000	1	6500	13	15,000	2	30,000
542	600	58	2500	37	7000	3	16,000	1	31,000
16	700	1	2700	39	8000	1	17,000	1	32,000
4	800	137	3000	1	8500	6	18,000	1	34,000
6	900	15	3500	15	9000	12	20,000	1	35,000
330	1000	81	4000	34	10,000	2	22,000	1	37,000
10	1200	12	4500	2	11,000	4	24,000	2	40,000
1	1300	75	5000	24	12,000	1	25,000	2	60,000
157	1500	—		—		—		—	
—		589	+	217	+	57	+	13=2759 *	
1883	+								

It will be observed, that the highest sum assessed in the above table is L. 60,000, but there are many people in Glasgow whose fortunes are greatly above this sum, and some who are possessed of three or four times its amount. A gentleman who died last year left above L. 300,000, made in the cotton manufacture.

State of Manners.

In an account of the progress of Glasgow, it may be proper to take some notice of the effect produced on manners, by the great increase of its population, and the employment of a considerable proportion of it, at an early period of life, in large factories. Although the injurious influence of these circumstances on the moral feeling and habits of the lower orders has been great, we do not think they have yet suffered so much as the people of the larger manufacturing communities of England; and we can only attribute this to the greater attention that is still bestowed here upon the education of this portion of society. But the progress of demoralization, latterly, has been greatly accelerated; and this, we think, is a consequence of the reduced and wretched circumstances of the operative class, acting in conjunction with the causes we have before mentioned. By Mr Cleland's *Tables*, the number of delinquents, incarcerated in the jail of Glasgow, in the year 1815, was 944. In 1819, the number was 1323. The average number of prisoners in bridewell, for the year 1810, was 90, while the average number in 1819 was 220.

In reviewing the circumstances of a large manufacturing community, this melancholy consideration forces itself on the mind—that the discoveries in mechanics, and improvements in the various processes of production, intended by nature to increase the sum of man's comforts, should, in the way the affairs of the world are conducted, terminate always in lowering his condition. The end seems to be every where sacrificed to the means; and we find manufactures valued, not as they enable those employed in them to add to the amount of their enjoyments, but as they serve to increase the general revenue of the country. (T. T.)

Boundaries and Extent.

GLOUCESTERSHIRE, one of the English counties on the western side of the kingdom. On the north-east it is bounded by Warwickshire; on the north-west by Worcestershire; Oxfordshire and Berkshire bound it on the east; Wilts and Somerset on the south; and Hereford and Monmouth on the west. The greatest length is 70 miles, and the greatest breadth 35. Its area is 1718 square miles (including its rivers), or 1,099,520 acres.

Population.

By the census of 1801, the number of inhabitants appeared to be 250,809; and, in 1811, was found to be 285,514; of these 141,920 lived in the cities, or in those towns and large villages which contained upwards of 1000 souls. In this enumeration the city of Bristol is included; for, though it is a county of itself, and though a part of it stands within the county of Somerset, yet, in the two last Parliamentary surveys, it is considered a part of the county of Gloucester, within which division the greater portion of it is situated. The most considerable places, and their population, are the following:

Cities.

Bristol, -	76,433	Minchin Hampton,	3,246
Gloucester,	8,280	Painswick, -	3,201
Cheltenham, -	8,325	Horsley, -	2,925
Stroud, -	5,321	Dursley, -	2,580
Tewkesbury, -	4,820	Newent, -	2,538
Bisley, -	4,757	Tetbury, -	2,533
Cirencester, -	4,540		

The other towns, viz. King's Stanley, Colford, Watton under Edge, Fairford, Marshfield, Winchcomb, Chipping-Sodbury, Stow on the Wold, and Thornbury, contain each from 1000 to 2000 inhabitants.

The city of Bristol being accurately described in the *Encyclopædia*, we refer to that article, and merely add, that, since the publication of that work, a vast improvement has been made on the port. The river Avon, which was formerly nearly dry at low water, has been converted into a floating dock; so that the sharper built ships, which could not approach to the city, can now lie at the wharfs afloat at all times. Several docks have been con-

* See *Enumeration of the Inhabitants of Glasgow, with Statistical Tables*, by James Cleland.

Gloucestershire.

structed, and a new canal formed, over which are handsome iron bridges. The enormous expence of these works was almost wholly defrayed by the citizens; and though the tolls produce but slight dividends on the capital, they have added to the facilities of the navigation, and have increased the beauty of the environs.

Commerce.

The foreign commerce of this county centres almost wholly in Bristol, as Gloucester, from the difficult navigation of the Severn, has but a small share of it. The principal trade is to the West India islands, where the rich capitalists of Bristol have either plantations of their own, or such mortgages on those of others, as secure to this port a large supply of all tropical productions. A considerable branch of commerce is the importation of Merino wool from Spain, which induces the clothiers of Wiltshire and Gloucestershire to depend on this market for the supply of their raw material.

With some parts of North America the direct intercourse is considerable; and the commerce with the Baltic, with the Elbe, and with Holland, as well as with the ports of Spain, Portugal, and Italy, though less than that of Liverpool, is next in order after that port. The slave trade was once carried on from hence to a considerable extent; but, to the honour of the Bristol merchants, it should be remembered, that they had relinquished all participation in it, long before that infamous traffic was abolished by the Legislature.

Internal Trade.

The internal trade of this county is, however, by far the most important. By the River Severn, which passes through it, it is enabled to maintain a regular intercourse with the potteries and glass manufactories of Worcestershire and Staffordshire; with the salt works of Droitwich; and with those parts of Warwickshire, Staffordshire, and Shropshire, which furnish the heavy iron goods that would not bear the expence of land-carriage. Though the Severn is only navigable for flat-bottomed vessels, and for those only at spring tides, yet the craft on that river is very considerable; and at Stourport there is a connection with all the numerous canals that traverse the centre of the kingdom. Besides the river Severn, the Wye is navigable for small craft to a considerable distance from its mouth, and facilitates the commercial intercourse with Monmouthshire and Herefordshire.

Canals.

Several navigable canals have been constructed in this county with the view of promoting its internal communication. The most remarkable of these is the Thames and Severn canal, which communicates with the latter river through the Stroud canal, and with the former river at the town of Lechlade. It was begun in 1783, and finished in ten years. The summit level is 241 feet above the level of the Stroud canal, and 130 feet above the river Thames at the place of its junction. These rises of level are surmounted by locks, admirably contrived and executed; and in one place it passes under the park of Lord Bathurst, through Sapperton tunnel, and, after being buried for the distance of two miles and five furlongs, again emerges near Cirencester. The tunnel is lined with masonry, arched above, and at the bottom has an inverted arch, except in some very few places, where, passing through a solid rock, that expence has been spared. The breadth of the canal is 42 feet at the top, and 30 feet at the bottom, and it is constructed for barges, adapted to the locks on the river Thames, as well as to those of the canal. The barges are 12 feet wide, from 70 to 80 feet long, when loaded, carry 70 tons, and draw about four feet of water. This work has, however, been more splendid than beneficial. The expence of its construction exceeded L. 250,000, and the tolls are scarcely more than sufficient to defray the expence of the necessary repairs. In fact, it connects two rivers, the navigation of both of which is bad; but especially that of the Thames, which, before it reaches Oxford, is subject to great expence in horses to draw the barges, which has many shallows where the vessels must be lightened to pass over them, and is liable to frequent impediments, sometimes from a scarcity of water, and sometimes from inundations. The trade which once passed through this canal has been diminished by the opening of the Kennet and Avon, which forms a better medium for the transit of goods from Bristol or Gloucester to London.

A canal, called the Berkley Canal, parallel to the River Severn, but which, by avoiding its sinuosities, shortens the navigation 20 miles, was begun in 1794. Though a valuable improvement, it languished many years, and is yet scarcely completed. The Hereford and Gloucester canal, designed to connect those two cities, passes near Boyce through a tunnel one mile and a quarter in length, between the Severn and Ledbury, to which place, a distance of 17 miles, the rise is 183 feet.

Mineral Productions.

The mineral riches of this county are almost wholly confined to iron; for though veins of lead exist at Sodbury, Deynton, and other places, they are not sufficiently productive of ore to induce the working of them. Iron is abundant in many parts of the county; but the principal forges are on the western side of the Severn, near Lydney, in the forest of Dean; where both charcoal and coal are abundantly produced. On both sides of the Severn coal is worked to a considerable extent. The forest of Dean contains upwards of 120 coal pits, from whence the city of Gloucester and its vicinity is supplied with that necessary. At Kingswood, near Bristol, there are considerable veins, but being at a great depth, the proprietors can scarcely compete with the miners of Monmouthshire, though by many of the inhabitants of the city, the coals of Kingswood are preferred to those brought by water from Newport. The mineral springs in this county, at Clifton, at Cheltenham, at Stow on the Wold, and at Bourton on the Water, are well known, and the two former places, as well by their natural beauties as by their medicinal waters, attract considerable numbers of occasional visitors, who there find all those accommodations which the best watering-places can afford. No part of the kingdom produces better or more abundant stone than is raised from the quarries of Gloucestershire. Limestone of excellent quality extends from Cromhall south-east to Sodbury; and south-west to Aust-Cliff; and the rocks of Clifton yield an excellent stone, from which much lime is made, both for domestic consumption and for ex-

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portation to the West Indies. Freestone is found on the Cotswold Hills, and near Lidney some gritstones are raised, which are adapted by the millwrights to their purposes.

Manufactures.

Gloucestershire is one of the chief manufacturing counties, and though a greater progress has been made of late years in the northern ones of Lancaster and York, it is still very much distinguished in this particular. The woollen manufacture has been long established, in what are provincially called *the Bottoms*, a district in the vallies, between the range where the Cotswold Hills, with a less elevation, assume the name of the Stroud Hills. Between the ranges of these hills there are clear and rapid streams, which supply the mills in which the manufactures are carried on. The principal seats of the manufactures are in the thickly peopled parishes of Bisley, Hampton, Stroud, Painswick, Woodchester, Horsley, Stonehouse, Stanley, Uley, Dursley, and Wotton-under-Edge. Almost the whole process is now performed by machinery except the weaving. The dyers in this district are celebrated for their scarlet, but more especially for their dark-blue colours, the excellence of which is attributed to some peculiar properties in the Stroud water. The greater part of the cloths of this county are dyed in the piece, not in the wool. Those of the superior quality, made from Merino wool, are destined either for the consumption of the kingdom, or for the supply of Russia; and some few are exported to America. The inferior kinds, made of the wool of the Cotswold, the Hereford, or the Southdown sheep, are mostly calculated for the markets of India and China. These are sent to London, white, and the agents of the East India Company select such as suit their demand, which are dyed to the requisite colours, and pressed and packed by their own different tradesmen in the vicinity of the metropolis. Cassimeres of the best quality are also made in this district to a very considerable extent.

In the city of Gloucester and its vicinity there are several considerable manufactories of pins, which, minute as is the article, furnish employment to upwards of 1500 persons. A bell foundery was established there in 1500, which has been continued to the present time, and is a kind of hereditary occupation in a family of the name of Rudhall, who have carried it on for the last hundred and fifty years, and during that period have cast several thousands of bells for different churches.

The vicinity of Bristol is crowded with manufactories of various kinds. The sugar refinery is very considerable, and produces some of the best kinds of white sugar. Glass of all kinds for windows and for domestic purposes, is made there. The copper and brass manufactures are large establishments. Hard white soap is an article of considerable importance: much is sent to London, and a large quantity exported to America and the West Indies. Hats, leather, saddlery, shoes, white-lead, gunpowder, earthenware, salt, snuff, and beer, are made in the city or neighbourhood of Bristol, and form the rudiments of its foreign trade, as well as administer to its domestic intercourse with the western counties, and with Wales.

Agriculture of the different districts.

The agriculture of Gloucestershire partakes of very different characters, according to the elevation of the land. On the eastern side of the county, a district of 200,000 acres, extending over the Cotswold Hills, is provincially distinguished by the name of *stone brash land*. This tract of country is very undulating, but none of the summits rise to a great height, so that the whole is cultivated. In the intervals between the ridges of hills, there are generally beautiful rivulets, by which the inhabitants are enabled so to irrigate their meadows, as to produce early grass for their young lambs. The hills, whatever be the surface, have uniformly a calcareous basis, which admirably adapts them for the growth of sainfoin. In no part of England is that valuable grass cultivated to so great an extent, or with such bountiful results. It has been an article of very ancient cultivation, and in this soil has the property of producing hay for twenty successive years. It requires, however, great care in the first laying down, and that all other grasses, as well as weeds, be eradicated; after which, as it draws its nourishment from a great depth, it has little or no tendency to exhaust the soil on the surface. In process of time it becomes choked by other grasses, when the land is again returned to the arable state. It is the practice of the best farmers to have one-seventh part of their land constantly bearing sainfoin. The remaining six portions of the farm are divided pretty nearly in equal proportions between turnips, barley, clover, or rye-grass, wheat, peas, and oats. The principal dependence for producing fertility is the large flocks of sheep which are bred here, and which are usually folded as a dressing for the turnips. It is a common practice to pare the soil, and burn it, that the weeds may be destroyed and the ashes furnish manure. The crops of barley are moderately good. Wheat is sown at very early periods, sometimes in August, but it seldom produces even a moderate crop if sowed later than September or early in October. The average produce of that grain does not exceed sixteen bushels to the acre, and it is not of the best quality. The soil is more congenial to the production of peas than to any other crop, and hence they form an important article of cultivation. The sheep of this district, for whose food, as the enumeration of the crops shows, the principal provision is made, are of a peculiar breed without horns, the wool rather long, and not of a very fine quality. They are said to be indigenous to these hills, but have been of late improved by crossing with other races. The Southdown sheep have recently been bred here, and are gradually acquiring a preference, as they do wherever they are introduced on soils of an inferior quality. Few parts of England have been more improved in cultivation within the last forty years than the Cotswold Hills. They have, however, in spite of this improvement, but a cold and barren appearance, owing to their being nearly destitute of trees, and to the want of verdant hedges; for the fences are almost uniformly stone walls, about four feet and a half in height. The farms are generally large, from 300 to 1200 acres, and the homesteads, as well as the cottages of the labourers, being usually situated in the vallies, and, therefore,

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not in sight at a distance, the face of the country has a poor and depopulated aspect. The depth of the soil is scarcely more than five inches: sometimes it is however very tenacious, but the experience of the natives has taught them, that even the most clayey soils do not require frequent ploughings. At each ploughing, considerable quantities of stone-rubble are brought to the surface.

To the westward of the Cotswold Hills, and inclining to the northwards, the rich vales of Evesham, Gloucester, and Berkley, are spread. The agricultural system which is practised, though it has some variations, is generally similar. The Vale of Evesham, a considerable part of which is in Worcestershire, is watered by the River Avon, and is highly productive in corn, pasture, and fruits. On the arable lands, the most general rotation is a clean fallow; then barley or oats; next beans or clover; and, lastly, wheat. The wheat is generally sown in November or December, the produce is commonly abundant, and the grain is of the best quality. The district is well wooded. The hedge rows are filled with elm, oak, ash, and maple trees, and the apple and pear trees are abundantly scattered in the fields, as well as in large orchards, near the villages. Cider and perry form very valuable portions of the produce of each farm. The proportion of arable land is small; the rich pastures feed numerous cows; and butter and cheese are the articles on which many farmers almost wholly depend.

The vale of Gloucester is in the form of an arch, of which the river Severn forms the chord. It is protected from the cold northerly and easterly winds by the Cotswold and Stroud hills, and hence is well adapted for the growth of fruit trees. Though there are now no vineyards, William of Malmsbury, in the twelfth century, said, "No county in England has more numerous or richer vineyards; or which yields grapes more abundantly or of better flavour, as the wine is but little inferior to that of France in sweetness." The apple and pear trees of the district yield, however, most profusely, liquors which, in the estimation of the inhabitants, are far preferable to any wine from foreign countries. The soil of this vale is generally of a rich sandy loam, on a very retentive and tenacious subsoil of clay. Fallowing is deemed indispensable on all the arable lands, which are thrown in very high ridges, about eight yards in breadth, with furrows between them, from twenty-four to thirty inches deep. Barley, oats, clover, beans, and wheat, yield most abundant crops, and of the best quality. The greater part of the land is, however, in permanent pasture, receiving no other manure than the feces of the cattle that are grazed on it; and, in some instances, the rich sediment deposited by occasional inundations. The meadows feed numberless cows, and the dairies, besides the cheese, whose name is derived from this county, furnish large quantities of butter, fatten many calves, and, with the whey and butter-milk, rear and fatten great numbers of swine. The swine are of a peculiarly large breed, and the market for them at Gloucester is by far the most considerable in the kingdom. The fattening of them does not, however, wholly depend on the dairy, but large quantities of oil-cake are applied to that purpose. The cheese denominated Gloucester has long enjoyed great celebrity both at home and abroad. It is usually made in the summer months, from May to October, inclusive. The number of cows belonging to individuals seldom exceed from thirty to forty. The uniformity of the quality is such, that the factors, who are the middle men, contract for the whole produce of the dairies without examining them, knowing the value of the cheese from the quality of the land on which the cows are pastured.

The vale of Berkley is separated from that of Gloucester by a natural intersection, and, like it, is bounded to the westward by the river Severn. Its surface is more irregular, but though the undulations are numerous, they are not excessive. The hills are hung with beech trees, and the face of the district is both rich and picturesque The soil is uniformly fertile in a very extraordinary degree. Nearly the whole is rich pasture or orchard, and the arable land does not form one-seventh part of the valley. The soil is a rich fat loam, occasionally mixed with a prolific clay, and generally resting on a retentive subsoil. The dairy farms are of smaller extent than in the adjoining vale, but they far excel them in the proportionate quantity of the cheese they yield, and the quality is also much superior. The cheese, commonly denominated *double Gloucester*, is almost wholly made in the vale of Berkley, and in the neighbourhood is known by that name. It is usually made in the months of May, June, and July, in dairies, where, later in the summer, a thinner kind is manufactured. Its excellence depends on attention to its management, as well as on the quality of the land on which the cattle are fed. The quantity of cheese made in this vale is about 1200 tons annually, and each cow is estimated to yield 350 pounds.

The western side of the Severn is principally occupied by the forest of Dean. It abounds with excellent oak and beech trees, and produces abundance of cider, especially one kind called Stire-cider, which is highly valued. The forest formerly contained 43,000 acres, but has been diminished by several royal grants; it is, however, now a most important district on account of the large ship timber which it produces. It abounds with coal and with iron ore, and the miners are regulated by peculiar courts.

The most remarkable curiosities of this county are the Roman antiquities at Woodchester, which have been accurately described by that indefatigable antiquary Lysons; the Roman roads, which traverse it in various directions; the numerous antique coins which have been frequently found in the fields; the vestiges of ancient fortifications, and the ruins of monastic edifices.

Chief Families and Seats.

This county has long conferred the title of Duke on a member of the royal family. It gives the title of Marquis of Camden to the family of Pratt, that of Earl Berkeley to the family of Berkeley, and that of Baron Shireborne to the family of Dutton. The number of noblemen and gentlemen's seats in this county is very considerable. The most remarkable are Badminton, Duke of Beaufort; Barnsley Park, Mr Musgrave; Batsford Park, Lord Redesdale;

Berkeley Castle, (late) Lord Berkeley; Blaze Castle, Mr Harford; Corse Court, Mr Dowdeswell; Doddington Park, Mr Codrington; Fairford, Mr Raymond Barker; Gatcombe Park, Mr David Ricardo; High Meadow House, Lord Gage; Highnam Court, Sir William Guise; King's Weston, Lord de Clifford; Lydney Park, Mr Bragge Bathurst; Miserden Park, Sir Edwin Sandys; Oakley Grove, Earl Bathurst; Randcomb Park, Bishop of Durham; Rodborough, Sir George Paul; Seizin Court, Sir Charles Cockerell; Sherborne, Lord Sherborne; Stowell Park, Mr Penrice; Toddington Hall, Mr Tracy; Totworth Court, Lord Ducie; Whitcombe Park, Sir William Hicks; Williamstrip Park, Mr Beech.

See Rudge's *Gloucestershire.*—Marshall's *Rural Economy of Gloucestershire.*—Rudden's *History of Gloucestershire.* — Bigland's *Gloucestershire.* — Fosbrook's *Gloucestershire.* — Lysons's *Gloucestershire Antiquities.*—Brayley and Britton's *Beauties of England and Wales.* (W.W.)

GOVERNMENT.

Nature of the Inquiry.

THE question with respect to Government, is a question about the adaptation of means to an end. Notwithstanding the portion of discourse which has been bestowed upon this subject, it is surprising to find, upon a close inspection, how few of its principles are settled. The reason is, that the ends and means have not been analyzed; and it is only a general and undistinguishing conception of them which exists in the minds of the greater number of men. So long as either remain in this situation, they give rise to interminable disputes; more especially when the deliberation is subject, as in this case, to the strongest action of personal interest.

Object of this Article.

In a discourse, limited as the present, it would be obviously vain to attempt the accomplishment of such a task, as that of the analysis we have mentioned. The mode, however, in which the operation should be conducted, may perhaps be described, and evidence enough exhibited to show in what road we must travel to approach the point at which so many have vainly endeavoured to arrive.

End of Government.

The end of government has been described in a great variety of expressions. By Locke it was said to be "the public good;" by others it has been described as being "the greatest happiness of the greatest number." These, and equivalent expressions, are just; they are only defective in as much as the particular ideas which they embrace are indistinctly announced; and different combinations are by means of them raised in different minds, and even in the same mind on different occasions.

It is immediately obvious, that a wide and difficult field is opened, and that the whole science of human nature must be explored to lay a foundation for the science of government. To understand what is included in the happiness of the greatest number, we must understand what is included in the happiness of the individuals of whom it is composed.

That dissection of human nature which would be necessary to show, on proper evidence, the primary elements into which human happiness may be resolved, it is not compatible with the present design to undertake. We must content ourselves with assuming certain results.

We may allow, for example, in general terms, that the lot of every human being is determined by his pains and pleasures; and that his happiness corresponds with the degree in which his pleasures are great, and his pains are small.

Human pains and pleasures are derived from two sources. They are produced either by our fellow men, or by causes independent of other men.

We may assume it as another principle, that the concern of government is with the former of these two sources; and that its business is to increase to the utmost the pleasures, and diminish to the utmost the pains, which men derive from one another.

Of the laws of nature, on which the condition of man depends, that which is attended with the greatest number of consequences, is the necessity of labour for obtaining the means of subsistence, as well as the means of the greatest part of our pleasures. This is, no doubt, the primary cause of government; for, if nature had produced spontaneously all the objects which we desire, and in sufficient abundance for the desires of all, there would have been no source of dispute or of injury among men; nor would any man have possessed the means of ever acquiring authority over another.

The results are exceedingly different, when nature produces the objects of desire not in sufficient abundance for all. The source of dispute is then exhaustless; and every man has the means of acquiring authority over others, in proportion to the quantity of those objects which he is able to possess. In this case, the end to be obtained, through government as the means, would be, to make that distribution of the scanty materials of happiness which would insure the greatest sum of it in the members of the community taken altogether; and to prevent every individual, or combination of individuals, from interfering with that distribution, or making any man to have less than his share.

An element of great importance is taken into the calculation, when it is considered that most of the objects of desire, and even the means of subsistence, are the product of labour. The means of insuring labour must, in that case, be provided for as the foundation of all.

The means for the insuring of labour are of two sorts; the one made out of the matter of evil, the other made out of the matter of good. The first sort is commonly denominated force; and, under its application, the labourers are slaves. This mode of procuring labour we need not consider; for, if the

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end of government be to produce the greatest happiness of the greatest number, that end cannot be attained by making the greatest number slaves.

The other mode of obtaining labour is by allurement, or the advantage which it brings. If we would obtain all the objects of desire in the greatest possible quantity, we must obtain labour in the greatest possible quantity; and, if we would obtain labour in the greatest possible quantity, we must raise the advantage attached to labour to the greatest possible height. It is impossible to attach to labour a greater degree of advantage than the whole of the product of labour. Why so? Because, if you give more to one man than the produce of his labour, you can do so only by taking it away from the produce of some other man's labour. The greatest possible happiness of society is, therefore, attained by insuring to every man the greatest possible quantity of the produce of his labour.

How is this to be accomplished? For it is obvious that every man who has not all the objects of his desire, has inducement to take them from any other man who is weaker than himself. And how is this to be prevented? One mode is sufficiently obvious; and it does not appear that there is any other. It is the union of a certain number of men, agreeing to protect one another; and the object is best accomplished when a great number of men combine together, and delegate to a small number the power necessary for protecting them all. This is government. And it thus appears, that it is for the sake of property that government exists. *

Means necessary to the Ends of Government.

With respect to the end of government, or that for the sake of which it exists, it is not conceived to be necessary, on the present occasion, that the analysis should be carried any farther. What follows is an attempt to analyze the means.

Two things are here to be considered; the power with which the small number are entrusted; and the use which they are to make of it.

With respect to the first, there is no difficulty. The elements, out of which the power of coercing others is fabricated, are obvious to all. Of these we shall, therefore, not lengthen this article by any explanation.

All the difficult questions of government relate to the means of restraining those, in whose hands are lodged the powers necessary for the protection of all, from making a bad use of it.

Whatever would be the temptations under which individuals would lie, if there was no government to take the objects of desire from others weaker than themselves, under the same temptations the members of government would lie, to take the objects of desire from the members of the community, if they were not prevented from doing so. Whatever, then, are the reasons for establishing government, the very same exactly are the reasons for establishing securities, that those entrusted with the powers necessary for protecting others make use of them for that purpose solely, and not for the purpose of taking from the members of the community the objects of desire.

Three simple Modes or Forms of Government.

There are three modes in which it may be supposed, that the powers of protecting the community are capable of being exercised. The community may undertake the protection of itself, and of its members. The powers of protection may be placed in the hands of a few. And, lastly, they may be placed in the hands of an individual. The Many, the Few, the One; these varieties appear to exhaust the subject. It is not possible to conceive any hands, or combination of hands, in which the powers of protection can be lodged, which will not fall under one or other of those descriptions. And these varieties correspond to the three forms of government, the Democratical, the Aristocratical, and the Monarchical.

It will be necessary to look somewhat closely at each of these forms in their order.

Of the Democratical Form.

I. *The Democratical.* It is obviously impossible, that the community in a body can be present to afford protection to each of its members. It must employ individuals for that purpose. Employing individuals, it must choose them, it must lay down the rules under which they are to act, and it must punish them, if they act in disconformity to those rules. In these operations are included the three great operations of government, Administration, Legislation, and Judicature. The community, to perform any of these operations, must be assembled. This circumstance alone seems to form a conclusive objection against the democratical form. To assemble the whole of a community as often as the business of government requires performance would almost preclude the existence of labour; hence the existence of property; and hence the existence of the community itself.

There is also another objection not less conclusive. A whole community would form a numerous assembly. But all numerous assemblies are essentially incapable of business. It is unnecessary to be tedious in the proof of this proposition. In an assembly, every thing must be done by speaking and assenting. But where the assembly is numerous, so many persons desire to speak, and feelings, by mutual inflammation, become so violent, that calm and effectual deliberation is altogether impossible.

It may be taken, therefore, as a proposition, from which there will be no dissent, that a community in mass is ill adapted for the business of government. There is no principle more in conformity with the sentiments and the practice of the people than this. The management of the joint affairs of any considerable body of the people they never undertake for

* It may be remarked, that the conclusion to which we have thus arrived coincides exactly with the doctrine of Locke: "The great and chief end," says he, "of men's uniting into commonwealths, and putting themselves under government, is the preservation of their property."—*Second Treatise concerning Government*, ch. ix. This the more certainly appears, when it is considered that by far the greater part of injuries to person committed by human beings are, in some way or other, on account of property.

themselves. What they uniformly do is, to choose a certain number of persons to be the actors in their stead. Even in the case of a common benefit club, the members choose a committee of management, and content themselves with a general control.

Of the Aristocratical Form.

2. *The Aristocratical.* This term applies to all those cases, in which the powers of government are held by any number of persons intermediate between a single person and the majority. When the number is small, it is common to call the government an Oligarchy; when it is considerable, to call it an Aristocracy. The cases are essentially the same; because the motives which operate in both are the same. This is a proposition which carries, we think, its own evidence along with it. We, therefore, assume it as a point which will not be disputed.

The source of evil is radically different in the case of aristocracy, and that of democracy. The community cannot have an interest opposite to its interest. To affirm this would be a contradiction in terms. The community within itself, and with respect to itself, can have no sinister interest. One community may intend the evil of another: never its own. This is an indubitable proposition, and one of great importance. It may act wrong from mistake. To suppose that it could from design, would be to suppose this absurdity, that human beings can wish their own misery.

The circumstances from which the inaptitude of the community as a body for the business of government arose, namely, the inconvenience of assembling them, and the inconvenience of their numbers when assembled, do not necessarily exist in the case of aristocracy. If the number of those who hold among them the powers of government is so great, as to make it inconsistent to assemble them, or impossible for them to deliberate calmly when assembled, this is only an objection to so extended an aristocracy, and has no application to an aristocracy not too numerous, when assembled for the best exercise of deliberation.

The question is, whether such an aristocracy may be trusted to make that use of the powers of government which is most conducive to the end for which government exists?

There may be a strong presumption, that an aristocracy, monopolizing the powers of government, would not possess intellectual powers in any very high perfection. Intellectual powers are the offspring of labour. But an hereditary aristocracy are deprived of the strongest motives to labour. The greater part of them will, therefore, be defective in those powers. This is one objection, and an important one, though not the greatest.

We have already observed, that the reason for which government exists is, that one man, if stronger than another, will take from him whatever that other possesses and he desires. But if one man will do this, so will several. And if powers are put into the hands of a comparatively small number, called an aristocracy, powers which make them stronger than the rest of the community, they will take from the rest of the community as much as they please of the objects of desire. They will, therefore, defeat the very end for which government was instituted. The unfitness, therefore, of an aristocracy to be entrusted with the powers of government rests on the basis of demonstration.

Of the Monarchical Form.

3. *The Monarchical.* It will be seen, and therefore words to make it manifest are unnecessary, that, in most respects, the monarchical form of government agrees with the aristocratical, and is liable to the same objections.

If government is founded upon this, as a law of human nature, that a man, if able, will take from others any thing which they have, and which he desires, it is sufficiently evident that, when a man is called a king, it does not change his nature; so that, when he has got power to enable him to take from every man what he pleases, he will take whatever he pleases. To suppose that he will not, is to affirm that government is unnecessary; and that human beings will abstain from injuring one another of their own accord.

It is very evident that this reasoning extends to every modification of the smaller number. Whenever the powers of government are placed in any hands other than those of the community, whether those of one man, of a few, or of several, those principles of human nature which imply that government is at all necessary, imply that these persons will make use of them to defeat the very end for which government exists.

One observation, however, suggests itself. Allowing, it may be said, that this deduction is perfect, and the inference founded upon it indisputable, it is yet true, that, if there were no government, every man would be exposed to depredation from every man; but, under government, if an aristocracy, he is exposed to it only from a few; if a monarchy, only from one.

This is a highly important observation, and deserves to be minutely investigated.

It is sufficiently obvious, that, if every man is liable to be deprived of what he possesses at the will of every man stronger than himself, the existence of property is impossible; and, if the existence of property is impossible, so also is that of labour, of the means of subsistence for an enlarged community, and hence of the community itself. If the members of such a community are liable to be deprived only by a few hundred men, the members of an aristocracy, it may not be impossible to satiate that limited number with a limited portion of the objects belonging to all. Allowing this view of the subject to be correct, it follows that the smaller the number of hands into which the powers of government are permitted to pass, the happier it will be for the community. That an oligarchy, therefore, is better than an aristocracy, and a monarchy better than either.

This view of the subject deserves to be the more carefully considered, that the conclusion to which it leads is the same with that which has been adopted and promulgated by some of the most profound and most benevolent investigators of human affairs. That government by one man, altogether unlimited and uncontrolled, is better than government by any modification of aristocracy, is the celebrated opinion of Mr Hobbes, and of the French *Economists*, supported on reasonings which it is not easy to con-

trovert. Government, by the many, they with reason considered an impossibility. They inferred, therefore, that, of all the possible forms of government, absolute monarchy is the best.

Experience, if we look only at the outside of the facts, appears to be divided on this subject. Absolute monarchy, under Neros and Caligulas, under such men as Emperors of Morocco and Sultans of Turkey, is the scourge of human nature. On the other side, the people of Denmark, tired out with the oppressions of an aristocracy, resolved that their king should be absolute; and, under their absolute monarch, are as well governed as any people in Europe. In Greece, notwithstanding the defects of democracy, human nature ran a more brilliant career than it has ever done in any other age or country. As the surface of history, therefore, affords no certain principle of decision, we must go beyond the surface, and penetrate to the springs within.

Where it is said that one man, or a limited number of men, will soon be satiated with the objects of desire, and when they have taken from the community what suffices to satiate them, will protect its members in the enjoyment of the remainder, it appears that an important element of the calculation is left out. Human beings are not a passive substance. If human beings, in respect to their rulers, were the same as sheep in respect to their shepherd; and if the king, or the aristocracy, were as totally exempt from all fear of resistance from the people, and all chance of obtaining more obedience from severity, as the shepherd from the sheep, it does appear that there would be a limit to the desire of taking to one's self the objects of desire. The case will be found to be very much altered when the idea is taken into the account of the resistance to their wills which one human being may expect from another, and of that perfection in obedience which fear alone can produce.

That one human being will desire to render the person and property of another subservient to his pleasures, notwithstanding the pain or loss of pleasure which it may occasion to that other individual, is the foundation of government. The desire of the object implies the desire of the power necessary to accomplish the object. The desire, therefore, of that power which is necessary to render the persons and properties of human beings subservient to our pleasures, is a grand governing law of human nature.

What is implied in that desire of power? and what is the extent to which it carries the actions of men? are the questions which it is necessary to resolve, in order to discover the limit which nature has set to the desire of a king, or an aristocracy, to inflict evil upon the community for their own advantage.

Power is a means to an end. The end is every thing, without exception, which the human being calls pleasure, and the removal of pain. The grand instrument for attaining what a man likes, is the actions of other men. Power, in its most appropriate signification, therefore, means security for the conformity between the will of one man and the acts of other men. This, we presume, is not a proposition which will be disputed. The master has power over his servant, because when he wills him to do so and so, in other words, expresses a desire that he would do so and so, he possesses a kind of security that the actions of the man will correspond to his desire. The general commands his soldiers to perform certain operations, the king commands his subjects to act in a certain manner, and their power is complete or not complete, in proportion as the conformity is complete or not complete between the actions willed and the actions performed. The actions of other men, considered as means for the attainment of the objects of our desire, are perfect or imperfect, in proportion as they are or are not certainly and invariably correspondent to our will.—There is no limit, therefore, to the demand of security for the perfection of that correspondence. A man is never satisfied with a smaller degree if he can obtain a greater. And as there is no man whatsoever, whose acts, in some degree or another, in some way or another, more immediately or more remotely, may not have some influence as means to our ends, there is no man, the conformity of whose acts to our will we would not give something to secure. The demand, therefore, of power over the acts of other men is really boundless. It is boundless in two ways; boundless in the number of persons to whom we would extend it, and boundless in its degree over the actions of each.

It would be nugatory to say, with a view to explain away this important principle, that some human beings may be so remotely connected with our interests, as to make the desire of a conformity between our will and their actions evanescent. It is quite enough to assume, what nobody will deny, that our desire of that conformity is unlimited, in respect to all those men whose actions can be supposed to have any influence on our pains and pleasures. With respect to the rulers of a community, this at least is certain, that they have a desire for the uniformity between their will and the actions of every man in the community. And for our present purpose this is as wide a field as we need to embrace.

With respect to the community, then, we deem it an established truth, that the rulers, one, or a few, desire an exact uniformity between their will and the acts of every member of the community. It remains for us to inquire to what description of acts it is the nature of this desire to give existence.

There are two classes of means, by which the conformity between the will of one man and the acts of other men may be accomplished. The one is pleasure, the other pain.

With regard to securities of the pleasurable sort for obtaining a conformity between one man's will and the acts of other men, it is evident, from experience, that when a man possesses a command over the objects of desire, he may, by imparting those objects to other men, insure to a great extent the conformity between his will and their actions. It follows, and is also matter of experience, that the greater the quantity of the objects of desire, which he may thus impart to other men, the greater is the number of men between whose actions and his own

will he can insure a conformity. As it has been demonstrated that there is no limit to the number of men whose actions we desire to have conformable to our will, it follows, with equal evidence, that there is no limit to the command which there are motives for endeavouring to possess over the objects of desire.

It is, therefore, not true, that there is in the mind of a king, or in the minds of an aristocracy, any point of saturation with the objects of desire. The opinion, in examination of which we have gone through the preceding analysis, that a king or an aristocracy may be satiated with the objects of desire, and, after being satiated, leave to the members of the community the greater part of what belongs to them, is an opinion founded upon a partial and incomplete view of the laws of human nature.

We have next to consider the securities of the painful sort which may be employed for attaining conformity between the acts of one man and the will of another. We are of opinion, that the importance of this part of the subject has not been duly considered; and that the business of government will be ill understood, till its numerous consequences have been fully developed.

Pleasure appears to be a feeble instrument of obedience in comparison with pain. It is much more easy to despise pleasure than pain. Above all it is important to consider, that in this class of instruments is included the power of taking away life, and with it of taking away not only all the pleasures of reality, but, what goes so far beyond them, all the pleasures of hope. This class of securities is, therefore, incomparably the strongest. He who desires obedience to a high degree of exactness, cannot be satisfied with the power of giving pleasure, he must have the power of inflicting pain. He who desires it to the highest possible degree of exactness, must desire power of inflicting pain sufficient at least to insure that degree of exactness; that is, an unlimited power of inflicting pain; for, as there is no possible mark by which to distinguish what is sufficient and what is not, and as the human mind sets no bounds to its avidity for the securities of what it deems eminently good, it is sure to extend, beyond almost any limits, its desire of the power of giving pain to others.

So much with respect to the motive for having and holding power of inflicting pain upon others. It may, however, be said, that how inseparable a part soever of human nature it may appear to be to desire to possess unlimited power of inflicting pain upon others, it does not follow, that those who possess it will have a desire to make use of it.

This is the next part of the inquiry upon which we have to enter; and we need not add that it merits all the attention of those who would possess correct ideas upon a subject which involves the greatest interests of mankind.

The chain of inference, in this case, is close and strong, to a most unusual degree. A man desires that the actions of other men shall be instantly and accurately correspondent to his will. He desires that the actions of the greatest possible number shall be so. Terror is the grand instrument. Terror can work only through assurance that evil will follow any want of conformity between the will and the actions willed. Every failure must, therefore, be punished. As there are no bounds to the mind's desire of its pleasure, there are of course no bounds to its desire of perfection in the instruments of that pleasure. There are, therefore, no bounds to its desire of exactness in the conformity between its will and the actions willed; and by consequence to the strength of that terror which is its procuring cause. Every, the most minute, failure, must be visited with the heaviest infliction; and, as failure in extreme exactness must frequently happen, the occasions of cruelty must be incessant.

We have thus arrived at several conclusions of the highest possible importance. We have seen, that the very principle of human nature upon which the necessity of government is founded, the propensity of one man to possess himself of the objects of desire at the cost of another, leads on, by infallible sequence, where power over a community is attained, and nothing checks, not only to that degree of plunder which leaves the members (excepting always the recipients and instruments of the plunder) the bare means of subsistence, but to that degree of cruelty which is necessary to keep in existence the most intense terror.

The world affords some decisive experiments upon human nature, in exact conformity with these conclusions. An English gentleman may be taken as a favourable specimen of civilization, of knowledge, of humanity, of all the qualities, in short, that make human nature estimable. The degree in which he desires to possess power over his fellow-creatures, and the degree of oppression to which he finds motives for carrying the exercise of that power, will afford a standard from which, assuredly, there can be no appeal. Wherever the same motives exist, the same conduct, as is displayed by the English gentleman, may be expected to follow in all men not farther advanced in human excellence than him. In the West Indies, before that vigilant attention of the English nation, which now, for thirty years, has imposed so great a check upon the masters of slaves, there was not a perfect absence of all check upon the dreadful propensities of power. But yet it is true, that these propensities led English gentlemen, not only to deprive their slaves of property, and to make property of their fellow-creatures, but to treat them with a degree of cruelty, the very description of which froze the blood of their countrymen, who were placed in less unfavourable circumstances. The motives to this deplorable conduct are exactly those which we have described above, as arising out of the universal desire to render the actions of other men exactly conformable to our will. It is of great importance to remark, that not one item in the motives which had lead English gentlemen to make slaves of their fellow-creatures, and to reduce them to the very worst condition in which the negroes have been found in the West Indies, can be shown to be wanting, or to be less strong in the set of motives which universally ope-

rate upon the men who have power over their fellow-creatures. It is proved, therefore, by the closest deduction from the acknowledged laws of human nature, and by direct and decisive experiments, that the ruling one, or the ruling few, would, if checks did not operate in the way of prevention, reduce the great mass of the people subject to their power, at least to the condition of negroes in the West Indies.*

We have thus seen, that of the forms of government, which have been called the three simple forms, not one is adequate to the ends which government is appointed to secure; that the community itself, which alone is free from motives opposite to those ends, is incapacitated by its numbers from performing the business of government; and that whether government is entrusted to one or a few, they have not only motives opposite to these ends, but motives which will carry them, if unchecked, to inflict the greatest evils.

These conclusions are so conformable to ordinary conceptions, that it would hardly have been necessary, if the developement had not been of importance for some of our subsequent investigations, to have taken any pains with the proof of them. In this country, at least, it will be remarked, in conformity with so many writers, that the imperfection of the three simple forms of government is apparent; that the ends of government can be attained in perfection, only as under the British constitution, by an union of all the three.

Union of the three simple Forms of Government.

The doctrine of the union of the three simple forms of government is, then, the next part of this important subject, which we are called upon to examine.

The first thing which it is obvious to remark upon it is, that it has been customary, in regard to this part of the inquiry, to beg the question. The good effects which have been ascribed to the union of the three simple forms of government, have been *supposed;* and the supposition has commonly been allowed. No proof has been adduced; or if any thing having the appearance of proof, it has only been a reference to the British constitution. The British constitution, it has been said, is an union of the three simple forms of government, and the British government is excellent. To render the instance of the British government in any degree a proof of the doctrine in question, it is evident that three points must be established; 1*st*, That the British government is not in show but in substance an union of the three simple forms; 2*dly*, That it has any peculiar excellence; and, 3*dly*, That its excellence arises from the union so supposed, and not from any other cause. As these points have always been taken for granted without examination, the question with respect to the effects of an union of the three simple forms of government may be considered as yet unsolved.

The positions which we have already established with regard to human nature, and which we assume as foundations, are these; that the actions of men are governed by their wills, and their wills by their desires; that their desires are directed to pleasure and relief from pain as *ends*, and to wealth and power as the principal means; that to the desire of these means there is no limit; and that the actions which flow from that desire are the constituents whereof bad government is made. Reasoning correctly from these acknowledged laws of human nature, we shall presently discover what opinion, with respect to the mixture of the different species of government, it will be incumbent upon us to adopt.

The theory in question implies, that of the powers of government, one portion is held by the king, one by the aristocracy, and one by the people. It also implies, that there is on the part of each of them a certain unity of will, otherwise they would not act as three separate powers. This being allowed, we proceed to the inquiry.

From the principles which we have already laid down, it follows, that of the objects of human desire, and (speaking more definitely) of the means to the ends of human desire, namely, wealth and power, each of the three parties will endeavour to obtain as much as possible. After what has been said, it is not suspected that any reader will deny this proposition; but it is of importance that he retain a very clear conception of it.

If any expedient presents itself to any of the supposed parties, any expedient effectual to that end, and not opposed to any preferred object of pursuit, we may infer, with certainty, that it will be adopted. One effectual expedient is not more effectual than obvious. Any two of them by combining may swallow up the third. That such combination will take place appears to be as certain as any thing which depends upon human will; because there are strong motives in favour of it, and none that can be conceived in opposition to it. Whether the portions of power, as originally distributed to the parties, be supposed to be equal or unequal, the mixture of three of the kinds of government, it is thus evident, cannot possibly exist.

This proposition appears to be so perfectly proved, that we do not think it necessary to dwell here upon the subject. As a part, however, of this doctrine of the mixture of the simple forms of government, it may be proper to inquire whether an union may not be possible of two of them.

Three varieties of this union may be conceived; the union of monarchy with aristocracy, or the union of either with democracy.

Let us first suppose that monarchy is united with aristocracy. The power of each is equal or not equal. If it is not equal, it follows, as a necessary consequence, from the principles which we have already established, that the stronger will take from

* An acute sense of this important truth is expressed by the President Montesquieu: "C'est une experience eternelle, que tout homme qui a du pouvoir est porté à en abuser; il va jusqu' à ce qu'il trouve de limites."—*Esp. de Loix,* II. 4.

the weaker, till it engrosses the whole. The only question, therefore, is, What will happen when the power is equal?

In the first place, however, it seems impossible that such equality should ever exist. How is it to be established? Or by what criterion is it to be ascertained? If there is no such criterion, it must, in all cases, be the result of chance. If so, the chances against it are as infinite to one. The idea, therefore, is wholly chimerical and absurd.

Besides an overweening propensity, a disposition to overrate one's own advantages, and underrate those of other men, is a well known law of human nature. Suppose, what would be little less than miraculous, that equality were established, this propensity would lead each of the parties to conceive itself the strongest. The consequence would be that they would go to war, and contend till one or other was subdued. Either those laws of human nature, upon which all reasoning with respect to government proceeds, must be denied, and then the utility of government itself may be disputed, or this conclusion is demonstrated. Again, if this equality were established, is there any human being who can suppose that it would last? If any thing be known about human affairs, it is this, that they are in perpetual change. If nothing else interfered, the difference of men, in respect of talents, would abundantly produce the effect. Suppose your equality to be established when your king is a man of talents, and suppose his successor to be the reverse, your equality no longer exists. The moment one of the parties is superior, it begins to profit by its superiority, and the inequality is daily increased. It is unnecessary to extend the investigation to the remaining cases—the union of democracy with either of the other two kinds of government: It is very evident that the same reasoning would lead to the same results.

pothesis Balance mixed vern- nts.

In this doctrine of the mixture of the simple forms of government is included the celebrated theory of the balance in the component parts of a government. By this, it is supposed, that when a government is composed of monarchy, aristocracy, and democracy, they balance one another, and by mutual checks produce good government. A few words will suffice to show, that, if any theory deserves the epithets of "wild, visionary, chimerical," it is that of the balance. If there are three powers, how is it possible to prevent two of them from combining to swallow up the third?

The analysis which we have already performed, will enable us to trace rapidly the concatenation of causes and effects in this imagined case. We have already seen that the interest of the community, considered in the aggregate or democratical point of view, is, that each individual should receive protection; and that the powers which are constituted for that purpose should be employed exclusively for that purpose. As this is a proposition wholly indisputable, it is also one to which all correct reasoning upon matters of government must have a perpetual reference.

We have also seen that the interest of the king, and of the governing aristocracy, is directly the reverse; it is to have unlimited power over the rest of the community, and to use it for their own advantage. In the supposed case of the balance of the monarchical, aristocratical, and democratical powers, it cannot be for the interest of either the monarchy or the aristocracy to combine with the democracy; because it is the interest of the democracy or community at large, that neither the king nor the aristocracy should have one particle of power, or one particle of the wealth of the community, for their own advantage. The democracy or community have all possible motives to endeavour to prevent the monarchy and aristocracy from exercising power, or obtaining the wealth of the community, for their own advantage. The monarchy and aristocracy have all possible motives for endeavouring to obtain unlimited power over the persons and property of the community. The consequence is inevitable; they have all possible motives for combining to obtain that power, and unless the people have power enough to be a match for both, they have no protection. The balance, therefore, is a thing, the existence of which, upon the best possible evidence, is to be regarded as impossible. The appearances which have given colour to the supposition are altogether delusive.

What then is to be done? For, according to this reasoning, we may be told that good government appears to be impossible. The people, as a body, cannot perform the business of government for themselves. If the powers of government are entrusted to one man, or a few men, and a monarchy, or governing aristocracy, is formed, the results are fatal. And it appears that a combination of the simple forms is impossible.

Notwithstanding the certainty of these propositions, it is not yet proved that good government is impossible. For though it is perfectly true that, as the people cannot exercise the powers of government themselves, they must entrust them to some one individual, or set of individuals, and these individuals will, infallibly, have the strongest motives to make a bad use of them; it is nevertheless possible that checks may be found sufficient to prevent the bad use of them. The next subject of inquiry, then, is the doctrine of checks. It is sufficiently conformable to the established and new-fashioned opinions to say, that, upon the right constitution of checks, all goodness of government depends. To this proposition we fully subscribe. Nothing, therefore, can exceed the importance of correct conclusions upon this subject. After the developements which we have already made, it is hoped that the inquiry will be neither intricate nor unsatisfactory.

Representative System, and Doctrine of Checks.

In the grand discovery of modern times, the system of representation, the solution of all the difficulties, both speculative and practical, will perhaps be found. If it cannot, we seem to be forced upon the extraordinary conclusion, that good government is impossible. For as there is no individual, or combination of individuals, except the community itself, who have not an interest in bad government, if entrusted with its powers; and as the community itself is incapable of exercising those powers, and must entrust them to some individual or combination of individuals, the conclusion is obvious. The community itself must check these individuals, or

they will follow their interest, and produce bad government. But how is it the community can check? The community can act only when assembled. And then it is incapable of acting. The community, however, can chuse representatives; and the question is, whether the representatives of the community can operate as a check?

We may begin by laying down two propositions, which appear to involve a great portion of the inquiry; and about which it is unlikely that there will be any dispute. The checking body must have a degree of power sufficient for the business of checking. It must also have an identity of interest with the community; otherwise it will make a mischievous use of its power.

The first question relates to the degree of power which is necessary to perform the business of checking. We need hardly excite the reader's attention to the importance of this inquiry; for upon this, it is evident that every thing depends.

To measure the degree of power which is requisite upon any occasion, we must consider the degree of power which is necessary to be overcome. Just as much as suffices for that purpose is requisite, and no more. We have then to inquire what power it is which the representatives of the community, acting as a check, need power to overcome. The answer here is easily given. It is all that power, wheresoever lodged, which they, in whose hands it is lodged, have an interest in misusing. We have already seen, that to whomsoever the community entrusts the powers of government, whether one, or a few, they have an interest in misusing it. All the power, therefore, which the one or the few, or which the one and the few combined, can apply to insure the accomplishment of their sinister ends, the checking body must have power to overcome, otherwise its check will be unavailing. In other words, there will be no check.

This is so exceedingly evident, that we hardly think it necessary to say a single word in illustration of it. If a king is prompted by the inherent principles of human nature to seek the gratification of his will; and if he finds an obstacle in that pursuit, he removes it, of course, if he can. If any man, or any set of men, oppose him, he overcomes them, if he is able; and to prevent him, they must, at the least, have equal power with himself.

The same is the case with an aristocracy. To oppose them with success in pursuing their interest at the expence of the community, the checking body must have power successfully to resist whatever power they possess. If there is both a king and an aristocracy, and if they would combine to put down the checking force, and to pursue their mutual interest at the expence of the community, the checking body must have sufficient power successfully to resist the united power of both king and aristocracy.

These conclusions are not only indisputable, but the very theory of the British constitution is erected upon them. The House of Commons, according to that theory, is the checking body. It is also an admitted doctrine, that if the king had the power of bearing down any opposition to his will that could be opposed by the House of Commons; or if the King and the House of Lords combined had the power of bearing down its opposition to their joint will, it would cease to have the power of checking them; that it must, therefore, have a power sufficient to overcome the united power of both.

All the questions which relate to the degree of power necessary to be given to that checking body, on the perfection of whose operations all the goodness of government depends, are thus pretty easily solved. The grand difficulty consists in finding the means of constituting a checking body, whose powers shall not be turned against the community for whose protection it is created. There can be no doubt, that, if power is granted to a body of men, called representatives, they, like any other men, will use their power, not for the advantage of the community, but for their own advantage, if they can. The only question is, therefore, how they can be prevented? in other words, how are the interests of the representatives to be identified with those of the community?

Each representative may be considered in two capacities; in his capacity of representative, in which he has the exercise of power over others, and in his capacity of member of the community, in which others have the exercise of power over him.

If things were so arranged, that, in his capacity of representative, it would be impossible for him to do himself so much good by misgovernment, as he would do himself harm in his capacity of member of the community, the object would be accomplished. We have already seen, that the amount of power assigned to the checking body cannot be diminished beyond a certain amount. It must be sufficient to overcome all resistance on the part of all those in whose hands the powers of government are lodged. But if the power assigned to the representative cannot be diminished in amount, there is only one other way in which it can be diminished, and that is, in duration.

This, then, is the instrument; lessening of duration is the instrument, by which, if by any thing, the object is to be accomplished. It is very evident, that the smaller the period of time during which any man retains his capacity of representative, as compared with the time in which he is simply a member of the community, the more difficult it will be to compensate the sacrifice of the interests of the longer period, by the profits of misgovernment during the shorter.

This is an old and approved method of identifying, as nearly as possible, the interests of those who rule, and the interests of those who are ruled. It is in pursuance of this advantage, that the members of the British House of Commons have always been chosen for a limited period. If the members were hereditary, or even if they were chosen for life, every inquirer would immediately pronounce that they would employ the powers entrusted to them for their own advantage, and that they would go just as far in abusing the persons and properties of the people, as their estimate of the powers and spirit of the people to resist them would let them regard it as safe.

As it thus appears, by the consent of all men, from the time when the Romans made their Consuls annual, down to the present day, that the end is to

 be attained by limiting the duration, either of the principal, or (what is better) of the checking power—the next question is, to what degree should the limitation proceed?

The general answer is plain. It should proceed, till met by overbalancing inconveniences on the other side. What then are the inconveniences which are likely to flow from a too limited duration?

They are of two sorts; those which affect the performance of the service, for which the individuals are chosen, and those which arise from the trouble of election. It is sufficiently obvious, that the business of government requires time to perform it. The matter must be proposed, deliberated upon, resolved, and executed. If the powers of government were to be shifted from one set of hands to another every day, the business of government could not proceed. Two conclusions, then, we may adopt with perfect certainty; that whatsoever time is necessary to perform the periodical round of the stated operations of government, this should be allotted to those who are invested with the checking powers; and, secondly, that no time, which is not necessary for that purpose, should by any means be allotted to them. With respect to the inconvenience arising from frequency of election, though, it is evident, that the trouble of election, which is always something, should not be repeated oftener than is necessary, no great allowance will need to be made for it, because it may easily be reduced to an inconsiderable amount.

As it thus appears, that limiting the duration of their power is a security against the sinister interest of the people's representatives, so it appears that it is the only security of which the nature of the case admits. The only other means which could be employed to that end, would be punishment on account of abuse. It is easy, however, to see, that punishment could not be effectually applied. For punishment, definition is required of the punishable acts, and proof must be established of the commission. But abuses of power may be carried to a great extent, without allowing the means of proving a determinate offence. No part of political experience is more perfect than this. If the limiting of duration be the only security, it is unnecessary to speak of the importance which ought to be attached to it.

It is necessary just to bring to notice, that, in the principle of limiting the duration of the power delegated to the representatives of the people, is not included the idea of changing them. The same individual may be chosen any number of times. The check of the short period for which he is chosen, and during which he can promote his sinister interest, is the same upon the man who has been chosen, and rechosen twenty times, as upon the man who has been chosen for the first time. And there is a good reason for always re-electing the man who has done his duty, because, the longer he serves, the better acquainted he becomes with the business of the service. Upon this principle of rechoosing, or of the permanency of the individual, united with the power of change, has been recommended the plan of permanent service with perpetual power of removal. This, it has been said, reduces the period within which the representative can promote his sinister interest to the narrowest possible limits; because the moment when his constituents begin to suspect him, that moment they may turn him out. On the other hand, if he continues faithful, the trouble of election is performed once for all, and the man serves as long as he lives. Some disadvantages, on the other hand, would accompany this plan. The present, however, is not the occasion on which the balance of different plans is capable of being compared.

Proper Constitution of a Representative Body.

Having considered the means which are capable of being employed for identifying the interest of the representatives, when chosen, with that of the persons who choose them, it remains that we endeavour to bring to view the principles which ought to guide in determining who the persons are by whom the choice ought to be performed.

It is most evident that every thing depends upon this question. It can be of no consequence to insure, by shortness of duration, a conformity between the conduct of the representatives and the will of those who appoint them, if those who appoint them have an interest opposite to that of the community; because those who choose will, according to the principles of human nature, make choice of such persons as will act according to their wishes. As this is a direct inference from the very principle on which government itself is founded, we assume it as indisputable.

We have seen already, that if one man has power over others placed in his hands, he will make use of it for an evil purpose; for the purpose of rendering those other men the abject instruments of his will. If we, then, suppose that one man has the power of choosing representatives for the people, it follows, that he will choose men who will use their power as representatives for the promotion of this his sinister interest.

We have likewise seen, that when a few men have power given them over others, they will make use of it exactly for the same ends, and to the same extent, as the one man. It equally follows, that, if a small number of men have the choice of the representatives, such representatives will be chosen as will promote the interests of that small number, by reducing, if possible, the rest of the community to be the abject and helpless slaves of their will.

In all these cases, it is obvious and indisputable, that all the benefits of the representative system are lost. The representative system is, in that case, only an operose and clumsy machinery, for doing that which might as well be done without it; namely, reducing the community to subjection under the One or the Few.

When we say the Few, it is seen that, in this case, it is of no importance whether we mean a few hundreds or a few thousands; or even *many* thousands. The operation of the sinister interest is the same; and the fate is the same of all that part of the community over whom the power is exercised. A numerous aristocracy has never been found to be less oppressive than an aristocracy confined to a few.

The general conclusion, therefore, which is evidently established is this; that the benefits of the representative system are lost, in all cases in which the interests of the choosing body are not the same with those of the community.

It is very evident, that if the community itself were the choosing body, the interest of the community and that of the choosing body would be the same. The question is, if that of any portion of the community, if erected into the choosing body, would remain the same?

One thing is pretty clear, that all those individuals whose interests are indisputably included in those of other individuals, may be struck off without inconvenience. In this light may be viewed all children, up to a certain age, whose interests are involved in those of their parents. In this light, also, women may be regarded, the interests of almost all of whom are involved either in that of their fathers or in that of their husbands.

Having ascertained that an interest identical with that of the whole community is to be found in the aggregate males, of an age to be regarded as *sui juris*, persons who may be regarded as the natural representatives of the whole population, we have to go on, and inquire, whether this requisite quality may not be found in some less number, some aliquot part of that body.

As degrees of mental qualities are not easily ascertained, they must be outward and visible signs which are taken to distinguish, for this purpose, one part of these males from another. The applicable signs of this description appear to be three: years; property; profession or mode of life.

According to the first of these means of distinction, a portion of the males, to any degree limited, may be taken, by prescribing an advanced period of life at which the power of voting for a representative should commence. According to the second, the elective body may be limited, by allowing a vote to those only who possess a certain amount of property or of income. According to the third, they may be limited, by allowing a vote only to such persons as belong to certain professions, or certain connections and interests. What we have to inquire is, if the interest of the limited number, set apart upon any of those principles as the organ of choice for a body of representatives, will be the same with the interest of the community?

Plan of Limiting the Right of Voting to Persons of a certain Age.

With respect to the first principle of selection, that of age, it would appear that a considerable latitude may be taken without inconvenience. Suppose the age of forty were prescribed as that at which the right of suffrage should commence, scarcely any laws could be made for the benefit of all the men of forty which would not be laws for the benefit of all the rest of the community.

The great principle of security here is, that the men of forty have a deep interest in the welfare of the younger men; for otherwise it might be objected with perfect truth, that if decisive power were placed in the hands of men of forty years of age, they would have an interest, just as any other detached portion of the community, in pursuing that career, which we have already described, for reducing the rest of the community into the state of abject slaves of their will. But it so happens (and it is a fully established law of human nature), that the great majority of old men have sons, whose interest they regard as an essential part of their own. There is, therefore, no great danger that, in such an arrangement as this, the interests of the young would be greatly sacrificed to those of the old.

Plan of making Property a qualification.

We come next to the inquiry, whether the interest of a body of electors, constituted by the possession of a certain amount of property or income, would be the same with the interest of the community?

It will not be disputed, that, if the qualification were raised so high that only a few hundreds possessed it, the case would be exactly the same with that of the consignment of the electoral suffrage to an aristocracy. This we have already considered, and have seen that it differs in form rather than substance from a simple aristocracy. We have likewise seen, that it alters not the case in regard to the community, whether the aristocracy be some hundreds or many thousands. One thing is, therefore, completely ascertained, that, unless the qualification be very low, it would only create an aristocratical government on a broad basis, and be accompanied with all the evils which we have shown to belong to an aristocratical government.

This question, however, deserves to be a little more minutely considered. Let us next take the opposite extreme. Let us suppose that the qualification is very low, so low as to include the great majority of the people. It would not be easy for the people who have very little property, to separate their interests from those of the people who have none. It is not the interest of those who have little property to give undue advantages to the possession of property, which those who have the great portions of it would turn against themselves. It may, therefore, be said, that there would be no evil in a low qualification. It can hardly be said, however, on the other hand, that there would be any good; for if the whole mass of the people who have some property would make a good choice, it will hardly be pretended that, added to them, the comparatively small number of those who have none, and whose minds are naturally and almost necessarily governed by the minds of those who have, would have any chance of making the choice a bad one.

We have ascertained, therefore, two points. We have ascertained that a very low qualification is of no use, as affording no security for a good choice beyond that which would exist if no pecuniary qualification was required. We have likewise ascertained, that a qualification so high as to constitute an aristocracy of wealth, though it were a very numerous one, would leave the community without protection, and exposed to all the evils of unbridled power. The only question, therefore, is, whether, between these extremes, there is any qualification which would remove the right of suffrage from the

people of small, or of no property, and yet constitute an elective body, the interest of which would be identical with that of the community?

It is not easy to find any satisfactory principle to guide us in our researches, and to tell us where we should fix. The qualification must either be such as to embrace the majority of the population, or something less than the majority. Suppose, in the first place, that it embraces the majority, the question is, whether the majority would have an interest in oppressing those who, upon this supposition, would be deprived of political power? If we reduce the calculation to its elements, we shall see that the interest which they would have, of this deplorable kind, though it would be something, would not be very great. Each man of the majority, if constituted the governing body, would have something less than the benefit of oppressing a single man. If the majority were twice as great as the minority, each man of the majority would only have one-half the benefit of oppressing a single man. In that case, the benefits of good government, accruing to all, might be expected to overbalance to the several members of such an elective body the benefits of misrule peculiar to themselves. Good government would, therefore, have a tolerable security. Suppose, in the second place, that the qualification did not admit a body of electors so large as the majority, in that case, taking again the calculation in its elements, we shall see that each man would have a benefit equal to that derived from the oppression of more than one man; and that, in proportion as the elective body constituted a smaller and smaller minority, the benefit of misrule to the elective body would be increased, and bad government would be insured.

It seems hardly necessary to carry the analysis of the pecuniary qualification, as the principle for choosing an elective body, any farther.

Plan of Limitation to certain Professions or Interests.

We have only remaining the third plan for constituting an elective body. According to the scheme in question, the best elective body is that which consists of certain classes, professions, or fraternities. The notion is, that when these fraternities or bodies are represented, the community itself is represented. The way in which, according to the patrons of this theory, the effect is brought about, is this. Though it is perfectly true, that each of these fraternities would profit by misrule, and has the strongest interest in promoting it; yet, if three or four of them are appointed to act in conjunction, they will not profit by misrule, and will have an interest in nothing but good government.

This theory of representation we shall not attempt to trace farther back than the year 1793. In the debate on the motion of Mr (now Earl) Grey, for a reform in the system of representation, on the 6th of May, of that year, Mr Jenkinson, the present Earl of Liverpool, brought forward this theory of representation, and urged it in opposition to all idea of reform in the British House of Commons, in terms as clear and distinct as those in which it has recently been clothed by leading men on both sides of that House. We shall transcribe the passage from the speech of Mr Jenkinson, omitting, for the sake of abbreviation, all those expressions which are unnecessary for conveying a knowledge of the plan, and of the reasons upon which it was founded.

"Supposing it agreed," he said, "that the House of Commons is meant to be a legislative body, representing all descriptions of men in the country, he supposed every person would agree, that the landed interest ought to have the preponderant weight. The landed interest was, in fact, the *stamina* of the country. In the second place, in a commercial country like this, the manufacturing and commercial interest ought to have a considerable weight, secondary to the landed interest, but secondary to the landed interest only. But was this all that was necessary? There were other descriptions of people, which, to distinguish them from those already mentioned, he should style professional people, and whom he considered as absolutely necessary to the composition of a House of Commons. By professional people, he meant those members of the House of Commons who wished to raise themselves to the great offices of the State; those that were in the army, those that were in the navy, those that were in the law." He then, as a reason for desiring to have those whom he calls "professional people" in the composition of the House of Commons, gives it as a fact, that country gentlemen and merchants seldom desire, and seldom have motives for desiring, to be ministers and other great officers of State. These ministers and officers, however, ought to be made out of the House of Commons. Therefore, you ought to have "professional people" of whom to make them. Nor was this all. "There was another reason why these persons were absolutely necessary. We were constantly in the habit of discussing in that House all the important concerns of the State. It was necessary, therefore, that there should be persons in the practice of debating such questions." "There was a third reason, which, to his mind, was stronger than all the rest. Suppose that in that House there were only country gentlemen, they would not then be the representatives of the nation, but of the landholders. Suppose there were in that House only commercial persons, they would not be the representatives of the nation, but of the commercial interest of the nation. Suppose the landed and commercial interest could both find their way into the House. The landed interest would be able, if it had nothing but the commercial interest to combat with, to prevent that interest from having its due weight in the constitution. All descriptions of persons in the country would thus, in fact, be at the mercy of the landholders." He adds, "the professional persons are, then, what makes this House the representatives of the people. They have collectively no *esprit de corps*, and prevent any *esprit de corps* from affecting the proceedings of the House. Neither the landed nor commercial interest can materially affect each other, and the interests of the different professions of the country are fairly considered. The honourable gentleman (Mr Grey), and the petition on this table, rather proposed uniformity of election. His ideas were the reverse—that the modes of election ought to be as varied as possible, because, if there was but one mode of election, there would, generally speaking, be but one

description of persons in that House, and by a varied mode of election only could that variety be secured."

There is great vagueness undoubtedly in the language here employed, and abundant proof of wavering and uncertainty in the ideas. The ideas, however, of this theory, appear in the same half-formed state in every speech and writing in which we have seen it adduced. It is this mist by which it has been kept surrounded which creates the only difficulty; because it cannot be precisely known how any thing is good or bad, till it is precisely known what it is.

According to the ideas of Lord Liverpool, the landholders ought to be represented; the merchants and manufacturers ought to be represented; the officers of the army and navy ought to be represented; and the practitioners of the law ought to be represented. Other patrons of the scheme have added, that literary men ought to be represented. And these, we believe, are almost all the fraternities which have been named for this purpose by any of the patrons of the scheme. To insure the choice of representatives of the landholders, landholders must be the choosers; to insure the choice of representatives of the merchants and manufacturers, merchants and manufacturers must be the choosers; and so with respect to the other fraternities, whether few or many. Thus, at least, it must be in *substance*, whatever the *form*, under which the visible acts may be performed. According to the scheme in question, these several fraternities are represented *directly*, the rest of the community is *not* represented directly; but it will be said by the patrons of that scheme, that it is represented *virtually*, which, in this case, answers the same purpose.

From what has already been ascertained, it will appear certain, that each of these fraternities has its sinister interest, and will be led to seek the benefit of misrule, if it is able to obtain it. This is frankly and distinctly avowed by Lord Liverpool. And by those by whom it is not avowed, it seems impossible to suppose that it should be disputed.

Let us now, then, observe the very principle upon which this theory must be supported. Three, or four, or five, or more clubs of men, have unlimited power over the whole community put into their hands. These clubs have, each, and all of them, an interest, an interest the same with that which governs all other rulers in misgovernment, in converting the persons and properties of the rest of the community wholly to their own benefit. Having this interest, says the theory, they will not make use of it, but will use all their powers for the benefit of the community. Unless this proposition can be supported, the theory is one of the shallowest which the pretenders to political wisdom have ever espoused.

Let us resume the proposition. Three, or four, or five fraternities of men, composing a small part of the community, have all the powers of government placed in their hands. If they oppose and contend with one another, they will be unable to convert these powers to their own benefit. If they agree they will be able to convert them wholly to their own benefit, and to do with the rest of the community just what they please. The patrons of this system of representation assume, that these fraternities will be sure to take that course which is *contrary* to their interest. That course which is *according* to their interest, they leave as if it had never presented itself to their imaginations!

There being two courses which the clubs may pursue, one contrary to their interest, the other agreeable to it, the patrons of the club system must prove, they must place it beyond all doubt, that the clubs will follow the first course, and not follow the second; otherwise the world will laugh at a theory which is founded upon a direct contradiction of one of the fundamental principles of human nature.

In supposing that clubs or societies of men are governed, like men individually, by their interests, we are surely following a pretty complete experience. In the idea that a certain number of those clubs can unite to pursue a common interest, there is surely nothing more extraordinary, than that as many individuals should unite to pursue a common interest. Lord Liverpool talks of an *esprit de corps* belonging to a class of landholders, made up of the different bodies of landholders in every county in the kingdom. He talks of an *esprit de corps* in a class of merchants and manufacturers, made up of the different bodies of merchants and manufacturers in the several great towns and manufacturing districts in the kingdom. What, then, is meant by an *esprit de corps*? Nothing else but a union for the pursuit of a common interest. To the several clubs supposed in the present theory, a common interest is created by the very circumstance of their composing the representing and represented bodies. Unless the patrons of this theory can prove to us, contrary to all experience, that a common interest cannot create an *esprit de corps* in men in combinations, as well as in men individually, we are under the necessity of believing, that an *esprit de corps* would be formed in the classes separated from the rest of the community for the purposes of representation; that they would pursue their common interest, and inflict all the evils upon the rest of the community to which the pursuit of that interest would lead.

It is not included in the idea of this union for the pursuit of a common interest, that the clubs or sets of persons appropriated to the business of representation should totally harmonize. There would, no doubt, be a great mixture of agreement and disagreement among them. But there would, if experience is any guide, or if the general laws of human nature have any power, be sufficient agreement to prevent their losing sight of the common interest; in other words, for insuring all that abuse of power which is useful to the parties by whom it is exercised.

The real effect of this motley representation, therefore, would only be to create a motley aristocracy; and, of course, to insure that kind of misgovernment which it is the nature of aristocracy to produce, and to produce equally, whether it is a uniform or a variegated aristocracy; whether an aristocracy all of landowners; or even aristocracy in part landowners, in part merchants and manufacturers, in part officers of the army and navy, and in part lawyers.

We have now, therefore, examined the principles

Government.

of the representative system, and have found in it all that is necessary to constitute a security for good government. We have seen in what manner it is possible to prevent in the representatives the rise of an interest different from that of the parties who choose them, namely, by giving them little time, not dependent upon the will of the parties. We have likewise seen in what manner identity of interest may be insured between the electoral body and the rest of the community. We have, therefore, discovered the means by which identity of interest may be insured between the representatives and the community at large. We have, by consequence, obtained an organ of government which possesses that quality, without which there can be no good government.

The question remains, whether this organ is competent to performance of the whole of the business of government? And it may be certainly answered, that it is not. It may be competent to the making of laws, and it may watch over their execution. But to the executive functions themselves, operations in detail, to be performed by individuals, it is manifestly not competent. The executive functions of government consist of two parts, the administrative and the judicial. The administrative, in this country, belong to the king; and it will appear indubitable, that, if the best mode of disposing of the administrative powers of government be to place them in the hands of one great functionary, not elective, but hereditary, a king, such as ours, instead of being inconsistent with the representative system in its highest state of perfection, would be an indispensable branch of a good government; and even if it did not previously exist, would be established by a representative body whose interests were identified, as above, with those of the nation.

The same reasoning will apply exactly to our House of Lords. Suppose it true, that, for the perfect performance of the business of legislation, and of watching over the execution of the laws, a second deliberative assembly is necessary, and that the end can best be attained by such an assembly as the British House of Lords, the proprietors of the greatest landed estates, with certain dignities and privileges annexed. It follows, that a body of representatives, whose interests were identified with those of the nation, would establish such an assembly, if it did not previously exist. For what reason? The most certain of all possible reasons; that they would have motives for, and none at all against it.

Examination of Objections to the extension of the Representative System.

Those parties, therefore, who reason against any measures necessary for identifying the interests of the representative body with those of the nation, under the plea that such a representative body would abolish the King and the House of Lords, are wholly inconsistent with themselves. They maintain that a King and a House of Lords, such as ours, are important and necessary branches of a good government. It is demonstratively certain that a representative body, the interests of which were identified with those of the nation, would have no motive to abolish them, if they were not causes of bad government. Those persons, therefore, who affirm that it would certainly abolish them, affirm implicitly that they are causes of bad, and not necessary to good government. This oversight of theirs is truly surprising.

The whole of this chain of deduction is dependent, as we stated at the beginning, upon the principles that the acts of men will be conformable to their interests. Upon this principle, we conceive that the chain is complete and irrefragable. The principle, also, appears to stand upon a strong foundation. It is undisputable that the acts of men follow their will; that their will follows their desires; and that their desires are generated by their apprehensions of good or evil; in other words, by their interests.

These apprehensions, however, may be just, or they may be erroneous. If just, the man's actions will be agreeable to his real interests. If erroneous, they will not be agreeable to his real interests, but to a false supposition of interest. This it is which creates the difficulty.

We have seen, that, unless the representative body are chosen by a portion of the community, the interest of which cannot be made to differ from that of the community, the interest of the community will infallibly be sacrificed to the interest of the rulers. The whole of that party of reasoners who support aristocratical power affirm, that a portion of the community, the interest of whom cannot be made to differ from that of the community, will not act according to their interest, but contrary to their interest. All their pleas are grounded upon this assumption; because, if such a portion of the community would act agreeably to their interest, which is the same with that of the community, they would act agreeably to the interest of the community, and the end of government would be obtained.

If this assumption of theirs is true, the prospect of mankind is deplorable. To the evils of misgovernment they are subject by inexorable destiny. If the powers of government are placed in the hands of persons whose interests are not identified with those of the community, the interests of the community are wholly sacrificed to those of the rulers. If so much as a checking power is held by the community, or by any part of the community, where the interests are the same as those of the community, the holders of that checking power will not, according to the assumption in question, make use of it in a way agreeable, but in a way contrary, to their own interest. According to this theory, the choice is placed between the evils which will be produced by design, the design of those who have the power of oppressing the rest of the community, and an interest in doing it; and the evils which may be produced by mistake, the mistake of those who, if they acted agreeably to their own interest, would act well.

Supposing that this theory were true, it would still be a question, between those two sets of evils, whether the evils arising from the design of those who have motives to employ the powers of government for the purpose of reducing the community to the state of abject slaves of their will, or the evils

arising from the misconduct of those who never produce evil but when they mistake their own interest, are the greatest evils.

Upon the most general and summary view of this question, it appears that the proper answer cannot be doubtful. They who have a fixed, invariable interest in acting ill, will act ill invariably. They who act ill from mistake, will often act well, sometimes even by accident, and in every case in which they are enabled to understand their interest, they will act well by design.

There is another and a still more important ground of preference. The evils which are the produce of interest and power united, the evils on the one side, are altogether incurable: the effects are certain, while that conjunction which is the cause of them remains. The evils which arise from mistake are not incurable; for, if the parties who act contrary to their interest had a proper knowledge of that interest, they would act well. What is necessary, then, is knowledge. Knowledge on the part of those whose interests are the same as those of the community would be an adequate remedy. But knowledge is a thing which is capable of being increased; and the more it is increased, the more the evils on this side of the case would be reduced.

Supposing, then, the theory of will opposed to interest to be correct, the practical conclusion would be, as there is something of a remedy to the evils arising from this source, none whatever to the evils arising from the conjunction of power and sinister interest, to adopt the side which has the remedy, and to do whatever is necessary for obtaining the remedy in its greatest possible strength, and applying it with the greatest possible efficacy.

It is no longer deniable that a great portion of knowledge is capable of being conveyed to a portion of the community, whose interests would be the same with those of the community. This being the only resource for good government, those who say that it is not yet attained stand in this dilemma: Either they do not desire good government, which is the case with all those who derive advantage from bad; or they will be seen employing their utmost exertions to increase the quantity of knowledge in the body of the community.

The practical conclusion, then, is actually the same, whether we embrace or reject the assumption that the community are little capable of acting according to their own interest.

That assumption, however, deserves to be considered. And it would need a more minute consideration than the space to which we are confined will enable us to bestow upon it.

One caution, first of all, we should take along with us; and it is this, that all those persons who hold the powers of government, without having an identity of interests with the community, and all those persons who share in the profits which are made by the abuse of those powers, and all those persons whom the example and representations of the two first classes, who, from the very supposition of their having the powers of government, must have the power of setting the fashion, and of influencing, to a large extent, the public mind,—all those persons will be sure to represent the community, or a part of the community having an identity of interest with the community, as incapable, in the highest degree, of acting according to their own interest; because this is the only resource of those who hold the powers of government without having that identity of interest; it being clear that they ought to hold them no longer, if those who have that identity of interest could be expected to act in any tolerable conformity with their interest. All representations from that quarter, therefore, of their incapability so to act, are to be received with suspicion. They come from interested parties; they come from parties who have the strongest possible interest to deceive themselves, and to endeavour to deceive others.

It is impossible that the interested endeavours of all those parties should not propagate, and for a long time successfully uphold, such an opinion, to whatever degree it might be found, upon accurate inquiry, to be without foundation. A parallel case may be given. It was the interest of the priesthood, when the people of Europe were all of one religion, that the laity should take their opinions exclusively from them; because, in that case, the laity might be rendered subservient to the will of the clergy, to any possible extent; and as all opinions were to be derived professedly from the Bible, they withdrew from the laity the privilege of reading it. When the opinions which produced the Reformation, and all the blessings which may be traced to it, began to ferment, the privilege of the Bible was demanded. The demand was resisted by the clergy, upon the very same assumption which we have now under contemplation. "The people did not understand their own interest. They would be sure to make a bad use of the Bible. They would derive from it not right opinions, but all sorts of wrong opinions." *

There can be no doubt, that the assumption in the religious case was borne out by still stronger appearance of evidence than it is in the political. The majority of the people may be supposed less capable of deriving correct opinions from the Bible, than of judging who is the best man to act as a representative.

Experience has fully displayed the nature of the assumption in regard to religion. The power bestowed upon the people, of judging for themselves, has been productive of good effects, to a degree which has totally altered the condition of human nature, and exalted man to what may be called a different stage of existence.

For what reason is it, then, we are called upon to

* A most instructive display of these and similar artifices for the preservation of mischievous power, after the spirit of the times is felt to be hostile to it, may be seen in Father Paul's *History of the Council of Trent*.

believe, that, if a portion of the community, having an identity of interests with the whole community, have the power of choosing representatives, they will act wholly contrary to their interests, and make a bad choice?

Experience, it will be said, establishes this conclusion. We see that the people do not act according to their interests, but very often in opposition to them. The question is between a portion of the community, which, if entrusted with power, would have an interest in making a bad use of it, and a portion which, though entrusted with power, would not have an interest in making a bad use of it. The former are any small number whatsoever; who, by the circumstance of being entrusted with power, are constituted an aristocracy.

From the frequency, however great, with which those who compose the mass of the community act in opposition to their interests, no conclusion can, in this case, be drawn, without a comparison of the frequency with which those, who are placed in contrast with them, act in opposition to theirs. Now, it may with great confidence be affirmed, that as great a proportion of those who compose the aristocratical body of any country, as of those who compose the rest of the community, are distinguished for a conduct unfavourable to their interests. Prudence is a more general characteristic of the people, without the advantages of fortune, than of the people who have been thoroughly subject to their corruptive operation. It may surely be said, that if the powers of government must be entrusted to persons incapable of good conduct, they were better entrusted to incapables who have an interest in good government, than to incapables who have an interest in bad.

It will be said, that a conclusion ought not to be drawn from the unthinking conduct of the great majority of an aristocratical body, against the capability of such a body for acting wisely in the management of public affairs; because the body will always contain a certain proportion of wise men, and the rest will be governed by them. Nothing but this can be said with pertinency. And, under certain modifications, this may be said with truth. The wise and good in any class of men do, to all general purposes, govern the rest. The comparison, however, must go on. Of that body, whose interests are identified with those of the community, it may also be said, that if one portion of them are unthinking, there is another portion wise; and that, in matters of state, the less wise would be governed by the more wise, not less certainly than in that body, whose interests, if they were entrusted with power, could not be identified with those of the community.

If we compare in each of these two contrasted bodies the two descriptions of persons, we shall not find that the foolish part of the democratical body are more foolish than that of the aristocratical, nor the wise part less wise. Though, according to the opinions which fashion has propagated, it may appear a little paradoxical, we shall probably find the very reverse.

That there is not only as great a proportion of wise men in that part of the community which is not the aristocracy, as in that which is; but that, under the present state of education, and the diffusion of knowledge, there is a much greater, we presume, there are few persons who will be disposed to dispute. It is to be observed, that the class which is universally described, as both the most wise, and the most virtuous part of every community, the middle rank, are wholly included in that part of the community which is not the aristocratical. It is also not disputed, that in Great Britain the middle rank are numerous, and form a large proportion of the whole body of the people. Another proposition may be stated, with a perfect confidence of the concurrence of all those men who have attentively considered the formation of opinions in the great body of society, or, indeed, the principles of human nature in general. It is, that the opinions of that class of the people, who are below the middle rank, are formed, and their minds are directed by that intelligent and virtuous rank, who come the most immediately in contact with them, who are in the constant habit of intimate communication with them, to whom they fly for advice and assistance in all their numerous difficulties, upon whom they feel an immediate and daily dependence, in health and in sickness, in infancy and in old age; to whom their children look up as models for their imitation, whose opinions they have daily repeated, and account it their honour to adopt. There can be no doubt whatever that the middle rank, which gives their most distinguished ornaments to science, to art, and to legislation itself, to every thing which exalts and refines human nature, is that part of the community of which, if the basis of representation were now so far extended, the opinion would ultimately decide. Of the people beneath them, a vast majority would be sure to be guided by their advice and example.

The incidents which have been urged as exceptions to this general rule, and even as reasons for rejecting it, may be considered as contributing to its proof. What signify the irregularities of a mob, more than half composed, in the greater number of instances, of boys and idlers, and disturbing, for a few hours or days, a particular town? What signifies the occasional turbulence of a manufacturing district, peculiarly unhappy from a very great deficiency of a middle rank, as there the population almost wholly consists of rich manufacturers and poor workmen; with whose minds no pains are taken by any body; with whose afflictions there is no virtuous family of the middle rank to sympathize; whose children have no good example of such a family to see and to admire; and who are placed in the highly unfavourable situation of fluctuating between very high wages in one year, and very low wages in another? It is altogether futile with regard to the foundation of good government, to say that this, or the other portion of the people, may at this, or the other time, depart from the wisdom of the middle rank. It is enough that the great majority of the people never cease to be guided by that rank; and we may, with some confidence, challenge the adversaries of the people to produce a single instance to the contrary in the history of the world.

(F. F.)

GRANADA, NEW,

New Granada.

A PROVINCIAL government of Spanish America. At its first settlement it was usually denominated *Terra Firma*, at which time it included what is now the province of Caraccas, and the provinces in the isthmus of Darien. Since it has been erected into a viceroyalty, it has been called sometimes the kingdom of Santa Fé, but more correctly, the new kingdom of Granada. The northern extremity of this kingdom is in the 12° of north latitude, and the southern 3° 30′ south latitude. Its length is about 1070 English miles, and its mean breadth about 280 miles. On the eastern side the boundaries of Granada are the Portuguese provinces on the banks of the Maranon or River of Amazons, Spanish Guyana, and the province of Caraccas. On the south it is bounded by the River Amazons, from its junction with the River Negro. Its western boundary is the Pacific Ocean from Golfo-Dolce, between Costarica and Veragua, where it joins Guatimala, to the port of Payta, which divides it from Peru. On the north it is bounded by the Carribean Sea, from Cape de la Vela to the River Culebras. The whole extent is about 64,500 square leagues.

Boundaries and Extent.

No part of the globe furnishes a greater variety both of soil and climate, and in no other part can every production of every country be produced so well as in this viceroyalty. This arises from the great inequalities in the surface of the country, for it contains, within its limits, mountains, till lately supposed to be the highest in the world; and though it is now ascertained, that they are exceeded in height by those of Tartary, they may still be classed among the most singular productions of nature. As climate is regulated by elevation as much as by latitude, the inhabitants of New Granada may be said to live in the extremes of heat and cold, and in all the different degrees of temperature which are to be found between the two extremes of habitable countries. The situation of these mountains, their elevation, and their peculiar formation, as well as their productions, have received much light from the journeys of Baron Humboldt, whose patient and laborious investigations have been communicated to the public.

Mountains.

Although these stupendous chains of mountains extend through the whole of America, they attain their greatest elevation in the kingdom of New Granada, where the cone of Chimborazo reaches the height of 21,440 feet above the level of the sea. From the equator they insensibly decline in elevation, both towards the south and the north, till, in the latter direction, they dwindle into slight hills in the province of Choco. From the sources of the rivers St Juan and Atrato in that province, where the communication between the Carribean Sea and the Pacific Ocean may be most easily effected, the mountains begin again to raise themselves, and increase in elevation as the chain passes through the centre of the isthmus of Panama. They rise still higher in the province of Veragua and Costarica, continue increasing through the viceroyalty of Guatimala, and then entering Mexico, branch off in various directions, which will be noticed under the article MEXICO. As these chains of mountains are extended to the south, they decline in height, in a similar manner, so that, gradually lessening, they almost wholly disappear in Terra Magellanica, the southernmost extremity of the Continent. There are three ridges or chains of mountains passing from north to south through New Granada. There are, indeed, projections from these of considerable extent and magnitude, which protrude into the surrounding country, and sometimes break the continuity of the valleys which separate the chains; but to have a clear conception of their configuration, it will be better to follow the mode of classification which is adopted by Humboldt. The westernmost chain of the Andes in New Granada runs parallel to the Pacific Ocean at the distance of 150 miles: it begins in the neighbourhood of Carthagena, to the westward of it, separates the River Cauca from the province of Choco, and proceeds to the southward till it unites with the other two branches in the province of Popayan, whence they proceed in a single ridge till they have passed the equator, when they divide again into two ridges in the province of Quito. It is in that district that the greatest elevations are found, in the cones of Chimborazo 21,440 feet, Cayambe-Urcu 19,386 feet, Antisana 19,146 feet, Cotopaxi 18,891 feet, and Ilinissa 17,240 feet. There the volcanoes are most numerous and striking, and there the inhabitants are most frequently exposed to the devastations of earthquakes. In passing between the province of Choco and the river Cauca, the Andes scarce ever reach beyond the height of 4500 feet.

The central ridge of the Andes begins at the Sierra-nevada in the province of Santa Marta, whose highest peak is 16,000 feet above the level of the sea, and, as the limit of perpetual snow in that latitude is about 15,000 feet, its top is to be seen constantly white, and exhibiting a beautiful contrast to the deep azure of the cloudless sky. In its progress it separates the River Cauca from the Magdalena, till, beyond the sources of both these rivers, it unites with the other parallel ridges. It is the highest of the three; some of its loftiest points enter the regions of eternal frost and snow; and such are its asperities and precipices, that no one has ever ventured to pass from the Cauca to the Magdalena over this cordillera. The eastern ridge separates the River Magdalena from the plains on which the River Meta rises. It begins near Cape de la Vela, passes through the province of Merida and Santa Fé, and unites with the other two branches in Popayan. It is less elevated than the central ridge, but considerably higher than the western. None of its highest peaks ascend to the limits of perpetual snow, nor are

New Granada.

estimated at more than 12,000 feet above the level of the sea.

Besides these chains of mountains which run from north to south, others run from west to east, and enter the province of Venezuela; one beginning near the River Atrato forms the sierras of Abibé and of Cauca, crosses the River Magdalena, forms a narrow chain on the coast to Cape de la Vela, where it separates into two ridges, and they continue through Caraccas and Cumana, till they terminate near the Gulf of Paria in the Atlantic Ocean.

Another part of the Andes, though but a small portion of them is within the new kingdom of Granada, may not be improperly noticed here. It is called the Cordillera of the cataracts of the Orinoco. It runs between the 3° and 6° of northern latitude, contains the sources of the great River Meta, of the Guaviare, and of the Zama, and occasions the tremendous cataracts of Maypuré and Aturé. As it bends towards the southward it increases in height, and becomes extended in breadth, stretching towards the boundaries of the Portuguese territories. It has not yet been traced in many of its directions. It borders the uninhabited country in which the unknown sources of the Orinoco are supposed to be situated. It then extends to the eastward, and soon bends to the southward, passing the lake Parimé, and the hill of Ucucuamo, which, being formed of shining yellow mica, gave birth to those fables of an *El Dorado*, or Golden Region, which misled the great Sir Walter Raleigh, and a crowd of inferior adventurers. The Rivers Demerara, Berbice, and others in English, Dutch, and French Guyana, are supposed to derive their waters from some of the branches of this Cordillera.

The stupendous mountains of New Granada, from the quantity of snow which the direct rays of the sun perpetually dissolve on the higher points, and from the vapours which are collected by the whole of them, form reservoirs, from which are supplied those astonishing rivers which water all the valleys and plains of this immense continent.

Rivers.

In treating of the rivers which issue from these mountains, we remark, first, the Purumayo and the Cageta in the south, which rise in the mountains of Pastos, and, passing over an extensive plain, unite with the river of Amazons, and which are capable of being navigated almost to their sources. In the same direction, the Guaviare, a branch of the Orinoco, and the great river Meta, have their origin. They spring from that mass of the Cordilleras which touches the provinces of Neyva or Timona; they unite their streams at Carichina, and, running through their whole extent, over a country perfectly level, are capable of being used for purposes of internal navigation; and will, at some future period, probably, afford an easy access to the cities of Popayan, Santa Fé, and Quito. The rivers Cauca and Magdalena both rise near each other in the province of Popayan, in the vicinity of the capital, from the mountains of Guanacas. These two rivers are separated from each other by the impassable chain of the central Andes, till they have passed the Sierra of Guamosco, a little to the south of Mompox, where the two streams unite, and run to the Carribean Sea. The two rivers collect such vast quantities of water from the draining of the mountains which border them, whose streams run with a rapidity correspondent to the height from which they descend, and the valleys through which they pass are so confined, that the rapidity of their currents renders the upward navigation extremely difficult, while the descent is proportionally easy. From the city of Honda, the passage to Carthagena, or Santa Marta, may be made in eight or ten days, whilst it occupies more than thirty days, and requires the severe labour of numerous rowers, to return, in the most favourable seasons; but, when the waters are much swollen, as is the case at some seasons, it requires months to perform the voyage, and is attended with great danger and many inconveniences. The river Atrato, at the foot of the western Cordilleras, passes through one of the richest countries of the globe, both for its vegetable productions and for its mines of gold and of platina, which last mineral is exclusively found in the province of Choco, in which this river is placed. It is principally remarkable on account of the vicinity of its source to that of the river St Juan, which runs into the Pacific Ocean. The small rivulet St Pablo nearly unites them in the rainy season; and, to consummate the junction, a priest of one of the parishes has dug a small canal, by which the productions of the eastern have been carried to the western shores of America. By the narrow policy of Spain, both these rivers were forbidden to be navigated, because they were supposed favourable for contraband trade; and, though the restriction has been removed of late, the troubles which have agitated that country have prevented any great use being made of the channel of communication.

The other rivers whose copious streams water this favoured country are the Julia and the Catatumbo, which discharge themselves into the Gulf of Maracaybo; the Pedral or Sogamoso, and the Suarez, which run into the Magdalena and the Casanare; the Apure, and a multitude of smaller streams, which, in Europe, would be considered important rivers, that discharge their waters by the channel of the Meta into the Orinoco.

Climate.

Europeans, accustomed to behold the constant succession of seasons, can scarcely believe that, in the midst of the torrid zone, which they suppose to be visited with the eternal ardours of a burning sun, all the fruits of our climate can be produced in their fullest perfection at all periods. The succession of flowers, of fruits, and of pastures, is constant; and, within the same horizon, they may be seen budding, flowering, and bearing ripened and unripened fruits at the same time. Even the same tree may be seen in flower, with green and with ripe fruits, without any sensible declension in its vegetative faculties being perceived to arise from this constant reproduction. Although vegetation is constant through the whole of the new kingdom, there is a considerable difference arising from the influence of climate, which is created by the various bendings and aspects of the mountains, by the height of the station, the winds which prevail, and other local circumstances. We may experience the temperatures of all the climates of the world within the compass of a few

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leagues and their various productions may all be cultivated within the same limited space.

The parts of the country which are on the sea-coast experience great heat, but much tempered by the sea breezes in the day, and by the land winds at night, which latter, blowing from the cold and often snowy mountains, convey a coolness that is both refreshing to the senses, and salutary to the constitution. In the wet or warm season, at Carthagena, Santa Marta, and Maracaybo, Fahrenheit's thermometer varies from 85 to 90, and seldom rises higher than 94; and the degree of heat is nearly the same every where at the foot of the Cordilleras. In ascending the mountains, the thermometer gradually descends to the lowest point of congelation. A little below this point of congelation, nature seems to have lavished her bounties, by bestowing extensive plains of perpetual verdure, watered with innumerable rivulets, which descend from the snowy mountains most copiously at the warmest seasons, when they are most needed, and most beneficial.

The breadth of the Cordilleras is generally about 160 miles, and in no part much less than 100. There is, consequently, a sufficient portion of that moderate elevation and temperature which best comports with the subsistence and health of man. These positions are called by the inhabitants cold lands, to distinguish them from the tropical climates which are at the foot of the Cordilleras. The temperature varies but little. In a course of observations made daily for two years, at Santa Fé de Bogota, the thermometer never descended below 59, and never ascended more than three degrees above that point, in an apartment, the windows of which were always open. The greatest depression was in the months of June, July, and August, and the greatest elevation in January, February, and March. The city of Santa Fé is about 8700 feet above the level of the sea. The districts of Tunja, Pamplona, Merida, and Timana, are at nearly the same height; whilst Popayan is about two thousand feet lower. These are by far the most populous portions of New Granada, and what we remark of their productions will apply equally to all, with the exception of those parts which are at the foot of the mountains, in what is properly denominated by the inhabitants the hot countries.

From the equality of temperature, and from the abundant means of irrigation which the melted snow from the mountains produces, the vegetative power continues in equal operation during the whole year. As the leaves fall from the trees, new ones are constantly shooting forth, so that a superficial observer would suppose no change took place. The meadows are covered with an unvarying verdure, composed of grasses of great variety, and of odoriferous plants, which produce most rapid improvement in the cattle sent from the lower countries to be fattened on them.

Vegetable Productions.

The vegetable productions of the best peopled divisions of New Granada are similar to those of Europe. They have abundance of apples, pears, peaches, plumbs, figs, cherries, &c. and they are in bearing through the whole year. Wheat is both good and productive, and might be reaped in every month, but by a kind of understood agreement between the cultivators themselves, and between the masters and servants, it is sowed but twice, and they have one wheat harvest in January and the second in August. Humboldt, after diligent inquiry into the increase of wheat in different countries, states it in France, Germany, and Poland, to be from 5 to 6 for 1; in Hungary, Croatia, and Sclavonia, 8 to 10 for 1; in La Plata 12 for 1; in Northern Mexico 16 for 1, in Equinoxial Mexico 24 for 1; and in the province of Pasto, in New Granada, he says they commonly produce 25, and, in fertile years, 35 for 1.

Barley is sowed in every month of the year. It is not used as food for man, but is grown near the cities, and cut in a green state for the horses of the richer class. None is suffered to stand till harvest, except sufficient to furnish seed for the green crops of the following year. The markets of the cities of Santa Fé, Quito, and Popayan, are furnished with varieties of fruits which can meet in no other countries. The apples and pears of Europe, cherries and strawberries, are to be seen with plantains, bannanas, guavas, pine-apples, and the other productions of the tropical regions.

The potatoes, for which Europe is indebted to New Granada, are there of two species, though of the same genus. One, called Papas de Anno, is the same as has been transplanted and diffused through America and Europe, and which has numerous varieties. The other is called Papas de Criollas; they are more delicate of flavour, easier to be applied to various kinds of cookery, and so abundant in their increase as to obtain a general preference over every other vegetable as food for the inhabitants. These criollas are to be found in every altitude of the cold regions, even in those situations which are too cold for human existence. The seed from higher regions is necessary every year to renew them in the lower, when those produced there will not grow. The primitive stock maintains itself in the highest situations in all the openings of the woods: it is known as the Papa Silvestris, and is probably the origin of all the different species of that useful plant, which has become diffused throughout the world.

A most important vegetable production to the inhabitants of Santa Fé, is a root known there by the Indian name of Arracacha. It resembles somewhat the European celery, but grows to a much larger size, is of various colours, and branches out, in different directions, in shoots which, both in shape and size, resemble the horn of a large cow. Its flavour is pleasant, and it is accounted most nutritious, and is given to the sick and the convalescent on account of its lightness of digestion.

Olives, vines, oranges, and lemons, do not arrive at perfection on the elevated lands, and the inhabitants have no inducement to force them by artificial means, as they are abundantly and cheaply supplied from the warm regions which are within a few leagues of them. Such is the bounty of nature in dispensing her fruits, that little attention is given or required by man: the trees are never grafted nor the fields manured. Although Cocoa is very generally produced in every warm climate, yet from peculiarity of situation in the province of Guyaquil, one of the divisions of New Granada, it is raised with more facility, in greater quan-

New Granada. tities and of better quality than in any other part of the world. It delights in a moist soil, a warm climate, and requires shelter from the direct rays of the sun to bring it to full perfection. No other care is required in its cultivation, than to keep the ground clear of weeds, and to plant the shrub under the shade of some high trees. It usually grows from ten to sixteen feet in height, and occasionally attains to eighteen feet. It is divided into four or five branches as soon as it shoots up. The leaf is from four to six inches in length, and in breadth two-thirds the length, in colour like the orange, but somewhat lighter. The pods which contain the cocoa grow both from the stem and the branches, to about six inches in length, sometimes singly, but sometimes two in a cluster, when the smaller of the two does not ripen, the larger one appearing to extract the whole nutritive matter. The pod at first is of a deep green, but as it advances to maturity, gradually changes to a yellow colour. The pods are considered pleasant fruit, containing a substance of a viscid kind, in which the seeds are found. When first gathered, the seeds are very soft, being contained in a thin and transparent skin: they are dried in the sun, and in a short period become fit to be packed for the various markets which they are destined to supply. The cocoa trees yield two crops in each year, and both of equal goodness and abundance.

The most extraordinary production in the vicinity of the cocoa district is a species of grass called *Gamalote;* its blade resembles barley, but is longer, broader, thicker, and rougher. It grows in many places, and attains the prodigious height of eight or nine feet. In the time of the inundations it is beaten down, and becomes rotten, but as soon as the water has subsided and it begin to get dry, the heat of the sun produces a quickness of vegetation unknown to any other tribe of vegetables. In a few days it shoots up to its natural growth, and then furnishes to the proprietors of cattle the most nutritious means for fattening them that is known in any part of the world. Among the curious productions of this favoured climate, one deserves notice on account of its singularity and utility. On a shrub called Ubillo, similar to the Uva-espina, small berries are produced of a blackish colour, and very abundant. From the juice of this berry, without any other operation than merely expressing it, an excellent ink is procured. On its first application to paper, it assumes a scarlet colour, but by a short exposure to the air it becomes a beautiful black. Its colour is so durable, that when the hands are stained with it, great pains and much time is required to remove the stain. The berry is sometimes dried and reduced to powder, which is converted into a very useful portable ink, by the addition of water alone. The government is so satisfied with the durable colour of this ink, that the Viceroy of Santa Fé has issued a decree, which is still in force, forbidding any other ink to be used in the public records but that which is prepared from this berry. A tree called Tibar has its wood of a deep mulberry colour; it is beautifully veined and almost incorruptible; it is used for furniture to some small extent, but if introduced in more polished countries, would probably become an article of active commerce. A most valuable production is the plant called Trezlejon. It is about six feet in height, has no leaves except at the top, where they grow in a bunch, each leaf a foot and half broad, covered with white and soft cotton like down. It is a resinous plant, and a gum of delicate whiteness and great purity exudes from it. Those who travel in the mountainous countries use the down on the leaves to make beds; the leaves form coverings for their huts; the wood supplies them with fuel, and the gum is used for illumination in the churches, and on occasions of public festivals in the streets. The most important vegetable production of New Granada is the Cinchona, or Jesuits' bark, a production which has conferred most extensive benefits on the whole human race. The tree from which the bark is produced is called, in Santa Fé, *Palo de Calenturas* by the Spaniards, and *Cascara de Loxa* by the Indians. It grows principally on the mountains which surround the city of Loxa, in the southernmost part of the viceroyalty; but became known in Europe by the name of Peruvian bark, from that province having, at the period of Pizarro's conquest, formed a recent addition to the empire of the Incas. The tree is of a moderate height; its trunk is short, and produces several branches; the leaves are smooth, entire, and thick, and in shape resemble the head of a lance; they are about two inches broad, and three long. The top of each branch of the tree bears flowers resembling those of the lavender plant. These flowers turn red, and are succeeded by russet grains, flat, and resembling small leaves. It is difficult to procure these seeds from the tree in a perfect state, because, as they ripen, they immediately fall, and leave the pods dry and empty. The Indians, who knew its virtues, kept this tree long secret from the Spaniards, who only introduced bark into Europe in 1640. The lady of the viceroy having been attacked by a violent fever, the corregidor of Loxa administered the powder, and performed a cure. As she first distributed it, it obtained thereby the name of the countess's powder. In 1649, the procurer-general of the Jesuits of America returned to Rome with a considerable quantity of the powder, which the members of the society dispensed, and cured fevers, as if by magic. Hence, in France it acquired the name of *Poudre des peres,* and in England of *Jesuits' bark.* It has been found in other mountains in the equinoctial regions; and the examinations of that able botanist, Dr Mutis of Santa Fé, have been directed with great ability and effect, to discriminate the various species, and to ascertain the efficient value of them.

Vegetable ink. — Jesuits' Bark.

Cattle. The plains in the elevated parts of the viceroyalty are admirably calculated for the breeding and fattening of cattle, and the number of sheep and cows is very great. Many individual cultivators have flocks of twenty-five thousand sheep, others more, and even the poorest Indians have large flocks. The flesh is excellent, and the wool furnishes the inhabitants with warm clothing; but by the impolitic laws of Spain, which discourage manufactures in her colonies, no cloth is made; and therefore the domestic manufactures produce only blankets and coverlids, which are

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afterwards appropriated to clothe the poorer classes. The ewes produce lambs twice in the year, at Christmas and at St John's tide, or the European midsummer.

The black cattle are fattened on the elevated pastures in a very short period; they are brought from the extensive plains in the lower regions for that purpose, and improve rapidly by the change of climate; but whenever the contrary plan is adopted, and the cattle from the hills are sent to the low country, they become lean, sicken, and soon die, from the profuse perspiration which the change creates.

In the best inhabited parts of the viceroyalty, they are neither troubled with muskitos, jegos, or any venomous snakes. Hurricanes, tempests, and earthquakes are unknown near the capital; but the southern part of the country seems to be the theatre on which the latter exhibit their greatest force.

The temperate elevations are peculiarly healthy; the length of human life, and the increase of population consequent upon it, exceeds that in any other part of the Spanish dominions, and perhaps any other country in the globe. The most common disease is the dropsy, which afflicts all ages, but more especially advanced life. It is supposed to arise from that want of due perspiration, which is experienced in a climate of moderate temperature, and of unvaried uniformity. The common cure for this disease is a journey to the warm regions below them; if the removal is made by gradual descents from one warm situation to another, the patient does not suffer, but receives benefit, when thus removed even from extreme cold to extreme heat. Those who are most anxious to preserve their health change their residence from one climate to another annually.

What we have hitherto said relates to the most populous portions of the country, which are situated at the elevation of from 5000 to 9000 feet above the level of the sea. The country on the lower levels, such as Carthagena, Santa Marta, Rio de la Hacha, Maracaybo, Panama, and Choco, differ but little in soil, climate, and productions, from the islands in the West Indies, or from the Dutch, French, and English settlements in Guyana.

Those immense plains at the foot of the Cordilleras, which are crossed by the Meta, the Orinoco, and the numerous tributary streams which supply their waters, merit some notice. The whole country is a continued plain, covered with grasses, which grow to such a height and thickness as to be impassable, except on horseback. Travellers who cross them follow each other in single files, each keeping the same track; if they should deviate from it, they are exposed to the danger of losing themselves. These plains are stocked with unreclaimed sheep, horses, and cows in prodigious numbers, luxuriating on the spontaneous productions of the uncultivated and unexhausted soil. On these extensive districts, rich as they are in animal life, and in vegetative power, there are scarcely any owners of land; each takes what extent he pleases, and occupies it without interruption, and without any other measurement, than that of *walking* round a portion for eight, ten, or twelve days, according to his desire, for more or less extensive tracts. Those who wish to establish a cattle farm, *hacienda de ganado*, begin by constructing, on the spot they select, a house, the materials for which the palm trees supply them with. A few friends are joined with them, well mounted, and a provision of dried meat is furnished, when they proceed in quest of the cattle to stock the farm. They are easily found, by beating about in the high grass which conceals them; they are driven to the new habitation, are there branded on the horn with a hot iron, or their ears slit in some peculiar manner, so as to be recognised as cattle that have an owner. If they find any previously marked, they are dismissed from the selection, but all the others are considered, when marked, as belonging to the new farm. They frequently select, when driven into a large court or inclosure, such of the cows as are with calf, and are the best, which serve as a breeding stock, and, slaughtering the others, either dry them for distant consumption, or for their own food. Many of these haciendas have belonging to them from 60,000 to 100,000 head of black cattle, all branded or ear-marked. It is found less difficult than would be previously supposed to collect these extensive herds. In the unreclaimed state they are not vicious, and, being very well fed, they are not disposed to roam far. They are more easily conducted when in herds than when solitary, and the natives have acquired wonderful dexterity in catching them. The stocking a new hacienda is a kind of holiday, which collects to the spot all the most robust and agile inhabitants of considerable districts; abundance of meat is to be obtained for killing it; the sport is to them highly exhilarating, and the feast is prolonged through many days, accompanied with all the demonstrations of rustic hilarity.

This low country is, however, generally unhealthy, from the great humidity of the climate, the extensive woods, and the periodical inundations. From the month of June to December, the rivers Magdalena, Orinoco, Meta, and others, overflow their banks, and compel the inhabitants to take refuge in their canoes, with which they are all abundantly provided. The humid effects of these inundations remain long after the waters have subsided, and the exhalation from the power of a vertical sun generates diseases, whose effects are exhibited in the pale yellow complexions, and thin bodies of the inhabitants. The females produce but few children, and those of sickly constitutions; and depopulation would ensue without recruits from the higher lands, who are induced to emigrate to the plains by the ease with which all that life absolutely requires can be obtained. It is clear, that not the heat but the humidity of the climate creates the numerous debilitating infirmities of these plains; for in Maracaybo, Santa Marta, Rio de la Hacha, and other places on the banks of the rivers, equally warm, but not subject to inundations, and their consequent humidity, the inhabitants are as healthy, and live as long, as in the more temperate climates, either of the new or the old world.

Wild Animals.

In these warm countries there are many tigers, resembling those of Africa and Asia in size, and somewhat in fierceness; but in the colour of their skin, and in the spots, are more like the leopards of

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the ancient continent. They seldom attack human beings, but destroy considerable numbers of horses, cows, and sheep, and especially the wild hogs, which wander in herds of three or four hundred in some districts, and whose flesh and blood the tigers prefer. Some of these tigers, on the sea coast and banks of the rivers where they are abundant, feed on tortoises, they turn them on their backs with much dexterity, and then gorge themselves by sucking their blood at their leisure. No other quadrupeds are known in Santa Fé of the ferocious tribes. There are a few bears in the mountainous parts. They are shy and timid animals, avoiding and never attacking either man or the other inhabitants of the forests.

Besides the animals we have noticed, and which are not indigenous, but derived from the races imported from Europe, there are immense quantities of wild pigs. They are of two species, one of which, contended by some to be of European origin, is gregarious, and resembles ours in shape, but is smaller, is of a chesnut colour, and finds abundant subsistence on the fruits and roots in the forests. The other species is certainly indigenous. It forms burrows in the earth, which are occupied by a single male and female. They never wander far from their dens; they bring forth fewer young than the others, are rather smaller in size, and their flesh is deemed a preferable food.

There are two species of deer, one which wanders in large herds in the woods; the other sedentary, living in retired spots in pairs: both are smaller than the domesticated deer of Europe, and the wandering race the smallest of the two. Another species of deer, without horns, is found on the banks of the Meta and the Orinoco, called *Venados Pellones*. They are timid and swift, and have not yet been accurately described. They live in the thickest of the woods the greater part of the day, and only come to the savannahs to feed in the morning and evening. The least noise makes them take to flight. They have been classed by some persons as a species of gazelle or antelope; but the only good naturalist that has traversed these plains could not approach near enough to describe them with any confidence in his observation.

Indigenous animals.

Without entering into a circumstantial detail of the indigenous quadrupeds of New Granada, which are well known, we enumerate only some of those whose imperfect description deserve to be rectified, which we are enabled to do from the manuscripts of Don Pedro Vargas, a natural historian of considerable knowledge.

The Danta, or great beast, is one of those animals which most abounds in the marshy meadows and low plains of Santa Fé. This animal, which Buffon describes under the pompous title of the Elephant of the New World, is easily domesticated, and lives in the houses with the familiarity of a dog. He knows those who benefit him, and demonstrates his gratitude by numerous unequivocal symptoms. "I have seen one," says the naturalist just mentioned, "which went loose about the house, absented himself for several days occasionally in the woods, and returned when he chose it without compulsion. When after a drought, in which he appeared heavy and torpid, there was an appearance of rain, he seemed singularly enlivened and animated, and with evident delight ran about, turning up with his snout the straw and other light substances that lay about the farm-yard, in the same manner as the pigs did in similar circumstances."

The sloth, the ant-eater, and many other species of monkeys, as well as the armadillo, and a smaller kind called Cachicamos, are common in New Granada. With the exception of the sloth, all these animals are highly esteemed as food, as well by the whites as the Indians. Tortoises are bred in innumerable crowds in the river Orinoco, and, with their eggs, afford sustenance to the native Indians in that half of the year when the dry season permits their living on the banks of the Meta. On the river Orinoco, a little below its confluence with the Meta between Carichana and Caycara, there are some sandy shores, which the tortoises are fond of resorting to and there depositing their eggs. The inhabitants of the several places between that spot and Angostura regularly appoint a guard in the place to prevent the destruction of the eggs, which are thus protected, that they may make from them the oil which they use both for cookery and for lamps. The season of making this oil is the great jubilee of the inhabitants of these districts. In the months of April and March every year, all ages and both sexes are collected on these sands, where tents or temporary huts are erected to protect them from the rays of the sun. Some are employed in beating the eggs into great jars, others in purifying and boiling the oil; some seek amusement in the chace or in fishing; and each seems occupied with some favourite pursuit. The occupations of the day give place to the song and the dance at night. This kind of festival usually continues about three weeks, and is considered as the general annual fair of the country, where the traders and victuallers resort to exchange their provisions and goods for the oil, which is by their means diffused through the whole extent of the low country.

The Cabiai or river-hog is found in considerable numbers in all the rivulets and brooks. It is an amphibious animal, of delicious flavour when young, weighs about 150 lbs., is gregarious, and sometimes met with in large herds. It takes to the water for safety from its pursuers; but as it must frequently rise to the surface to breathe, it is easily taken by the natives, who are accustomed to, and fond of, the sport.

Alligators are very numerous in all the rivers of the plains, but more especially abound in the River Magdalena. One species of them grows to the length of 20 feet. The other kind is smaller, is seldom found in running streams, but inhabits lakes and stagnant waters; it will seldom attack a man unless provoked by excessive hunger, or in a situation in which it has no resource but fighting. A third kind is still more harmless, being quite tame, and it is not unfrequent to see persons bathing in the river with this species of alligator swimming near them.

The animal called by the Spanish Americans Manati, and by the French naturalists Lamantin, is

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found in the lakes and rushy pools of the warm climate. It is said to feed only on grass, and its flesh is reported to be of most delicious flavour, equalling in tenderness that of a lamb or a sucking pig, and not unlike the latter in taste. They are very abundant in the lakes of Zapatosa, in the river Sinu, and in the various streams which contribute to the Orinoco. During the inundations these animals are spread over the whole country. As the inundations subside, the natives erect stockades at the passages by which the waters return to their regular channels, and take great quantities of them. Some of them are 800 pounds weight, and, when first produced, weigh about 30 pounds. The fishery for this amphibious animal is of vast importance to the inhabitants, who feed on its flesh, and convert its skin to several useful purposes, but especially to horse-whips, for which it is admirably adapted. It is well known that the ruder inhabitants of warm climates esteem the iguana a delicious food; its description is familiar, but there is a species in New Granada of a dark colour, with white spots, the size of a water-dog. These, unlike the others, never ascend the trees, but, in running about, make a rustling on the decayed leaves, and utter cries somewhat resembling those of a tiger, to the great alarm of those unaccustomed to the sound.

Birds.

The birds of this region are very numerous, with plumage of the most brilliant and beautiful colours. The condour, or bustard of America, is a bird of great strength, sometimes eighteen feet from the extremity of wing to wing when extended. It is to be found in all the climates of South America, but makes its nest only in the high and cold regions, in the concavities of rocks covered with thorny plants, where it is inaccessible to man. It is fierce, and frequently commits depredations on the smaller kinds of animals. Migratory ducks, of very large size, and in innumerable flocks, make their appearance on the lakes in the months of January, February, and March. The natives who wish to take them float a great number of calabashes on the surface of the lakes they frequent, till the birds become familiarized to them. Men with calabashes on their heads, level with the water, then go into the pools, and the ducks permit their approach sufficiently near to seize them by the feet, and draw them under water. This they do without disturbing the flock, who are thus caught in very great numbers. The turbid state of the water in these pools is a very great assistant to the sportsmen in the taking this species of wild fowl. Another species of these ducks, migratory likewise, but in smaller numbers, is found of a beautiful rose colour, which are more highly valued as food by the natives than the others.

They have a bird which, for its curious instinct, deserves to be noticed. It is called the Trumpeter by the Spaniards, and Agami by the Indians. It is easily domesticated, and taught to act as a guide and protector of the other poultry. It will lead the turkies, parrots, and other fowls, to the fields to feed in the morning, conduct them home in the evening, and during the day give notice of the approach of any noxious animal, by the peculiar sounds from which it has obtained its name.

Gold and Silver Mines.

New Granada, though inferior in the quantity of the precious metals yielded by its mines to Mexico and Peru, is known to abound with all the mineral wealth which those two countries possess. Gold mines have been found in the mountains of Guamoco and Antioquia; but they are very slightly worked, and produce but little. The far greater part of the gold is obtained by washing the sand which is brought down by the torrents from the mountains. The washing places for gold (*lavaderos*) are to the westward of the central range of the Andes, in the provinces of Antioquia and Choco, in the valley of the river Cauca, and in the department of Barbacoa, on the shores of the Pacific Ocean. All the gold found in the viceroyalty is directed to be coined either in the mint at Santa Fé, or in that of Popayan. On an average of seven years, the quantity coined in both places amounted to about 7700 marks annually, or 61,600 ounces, worth L.240,000 Sterling. Of late years, the quantity has increased, and is stated to be nearly doubled. The province of Antioquia, whose entrance is impracticable for wheel carriages, and even for horses, contains very rich veins of gold, in micaceous slate, at Buritoca, San Pedro, and Armos; but, for want of hands, they are not yet worked. In the alluvial grounds of Santa Rosa, and in the valley of Orsos, the washing is performed by the labour of negro slaves; who, between the year 1770 and 1778, were increased from 1462 to 4896 individuals. None of the gold found in America is of the purest quality; that of Antioquia is of the fineness of 19 to 20 carats, of Barbacoas, $21\frac{1}{2}$ carats, Inderperdu, 22 carats, and of Giron 23 carats. At Marmato, to the west of the river Cauca, a whitish gold is procured, which does not exceed 12 or 13 carats fine, and which is mixed with silver. It is the true *electrum* of the ancients. In Choco, the richest river in gold is the Andageda, which, with two other streams, forms the great river Atrato. All the ground between the Andageda, the San Juan, and the Tamana, is auriferous. The largest lump of gold ever found in Choco weighed 25 pounds. The negro, who discovered it, did not, as was usual, and therefore expected, obtain his manumission. The master presented it to the royal cabinet of Spain, expecting to be rewarded with a title of Castile, the great object of desire to all the rich Creoles. He was, however, disappointed, and with difficulty obtained payment of its value. There are no other bounds to the finding of gold in Choco than that arising from the scarcity of labourers, which may be attributed to the neglect of agriculture; for the roads are too bad to admit of much foreign intercourse, and the inhabitants too intent on finding gold to apply to other labour, which, with patience and perseverance, would be more surely, and more extensively beneficial to them. New Granada possesses several rich mines of silver, but they are not worked to any great extent. About sixteen years ago, some rich veins were discovered at Vega de Supia, between the Cerro de Tacon, and the Cerro de Marmato. The operations were stopped by a lawsuit between the different proprietors, at the very moment the mine began to be productive. The working of the mines of Santa Anna, near Mariquita, and those of Pamplona, which had been suspended, was resumed

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a few years ago, and found to be very productive in silver ore, lying in beds of gneiss. The mine of Manta has been stopped by order of government, to prevent the ruin which threatened the numerous proprietors who were engaged in it. The expences were enormous, and though the ore contained six ounces of silver in each quintal, it afforded no prospect of reimbursing the expences of those who had embarked the capital in this hazardous enterprise.

Platina.

Platina is the exclusive production of New Granada; it is found only in the province of Choco, to the west of the Andes, and in the province of Barbacoa, between the 2d and 6th degree of north latitude. It is peculiar to one alluvial spot of ground, about six hundred square leagues. It is found in *Lavaderos*, principally at Condotto, Santa Reta, Santa Lucia, and the ravine of Iro, between the villages of Novita and Taddo.

Quicksilver.

To a country abounding with silver mines, mercury is indispensable for working them to advantage. The impolicy of the court of Spain, which has placed mercury under a royal monopoly, has, of necessity, imposed great restrictions on the mines of America. The government supplies the wants of the miners from Almadon, in Spain, in some degree, but principally from the mines of Istria. There are, however, in New Granada, as well as in Peru and Mexico, mines of quicksilver, which, with due encouragement and protection, would be sufficient to render the American dominions of Spain independent of Europe for the supply of this important mineral. Sulphureted mercury is found in the province of Antioquia, in the valley of Santa Rosa, to the eastward of the river Cauca, in the central Cordillera, between Ibague and Carthago, and in the province of Quito, between the villages of Azogue and Cuenca. The celebrated Professor Mutis made the discovery of the Cinnabar in the mines of Quindiu. At his own expence, in 1786, he caused the miners of Sapo to examine that part of the granite mountains which extends southward from the Nevada de Tolima towards the river Saldana. The sulphureted mercury was found in round fragments, mixed with small grains of gold in the alluvial earth, with which the ravine at the foot of the table land of Ibague is filled. Near the village of Azogue, to the north-west of Cuenca, the mercury is found as in the department of Mount Tonnerre, in Frana, in a formation of quartose freestone, with argillaceous cement. This freestone is near 1500 yards in thickness, and contains fossil wood and asphaltum. In the mountains of Guazon and Upar, to the north-east of Azogue, a vein of cinnabar traverses beds of clay filled with calcareous spar, and contained in freestone. This mine must have been formerly worked, as there are the remains of a gallery 130 yards in length. At five leagues distant from the city of Popayan, there is a ravine known by the name of the quicksilver ravine (quebrada de Azogue), from whence it is probable that mercury was formerly extracted, but at present no attempt at working it is made.

Iron, Coal, &c.

In New Granada, there are considerable iron veins, but they are forbidden to be worked, lest they should injure the iron manufactures of the peninsula; hence, though their situation is well known, and the richness of the ore ascertained, they have not been explored with that degree of diligence which the prospect of reaping benefit by their working would produce. Coal mines exist near the city of Santa Fé de Bogota, at the height of more than 8000 feet above the level of the sea; but, not being wanted for manufactories, wood being abundant, and the climate too warm to need fires in the apartments, they are not worked. There is also a most abundant mine of rock salt at Zepaquira, and, it is said, in other parts; but the wants of the inhabitants being abundantly supplied with salt from the sea-coast, there has been no necessity for bringing the other into use.

It is generally supposed that the richest mines are unexplored, and even unknown to the Spaniards. A sensible resident in Choco, whose notes are before us, says, "I know that in Choco, the Indians have knowledge of several rich mines of gold, whose existence they obstinately conceal from the whites, because they say they reserve them for themselves or their heirs, when they shall be freed from the Spanish yoke, which they all believe will some day happen."

Original Inhabitants.

When this part of America was first visited by the Spaniards, the natives were divided into various tribes, and lived in a state but little removed from the condition of the lowest savages. Some of the tribes had made more considerable advances, and were gradually subduing, and perhaps leading towards civilization, their ruder neighbours. Two states had risen to more eminence, and formed some kind of regular government. The Moscas or Muyscas had built their capital on the spot on which the present city of Santa Fé stands. Like most rude nations, their government was founded on superstition, and its origin supposed to be of divine institution. They had a prevalent tradition, that, at some remote period, a child of the sun, designated among them by the name of Bochica, had appeared, in some mysterious manner, and invested with supernatural power; that, in his contests with malignant beings, he had succeeded in rendering the plains habitable and fertile, and had recommended for their monarch Huncahua. This king mounted the throne; and, during a reign of two thousand years, extended his dominions, and introduced religion, and the arts of civilized life. The government was a theocracy; and the offices of king and high priest were united in him and his successors. The religion was of a sanguinary kind, and required the sacrifice of human victims. The first advances only had been made in knowledge; for, though they had a calendar which divided the year into weeks and months, they could only express numbers beyond ten by adding to them the word which signifies foot, and then counting the decimals by numbering the toes. They had attained the art of spinning cotton, and of weaving it, so as to form garments; and they had workmen who exercised some rude ingenuity in making ornaments of gold and silver. The mixed character of Monarch and High Priest, which was borne by their King, impressed a kind of awe on the inhabitants, which kept them in cheerful subjection. Their king never walked on foot, but was carried by men on a species of palan-

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kin, in paths strewed with flowers, by his willing subjects, whose respect and dread made them consider it an act of impiety even to look on his countenance. When the Spaniards first discovered this country, it was designated by the natives with the name of Cundinamarca, and the civil and ecclesiastical government was vested in a chief called Bogota, who was engaged in war, as his predecessors had long been, with the Muzos or Musos, a nation whose traditions and superstitions differing, had caused perpetual animosity with the Muyscas. The tradition of the Musos, concerning the origin of their race, taught them, that, in a remote period, the shadow of a man, or a spirit called Ari, was accustomed to make faces of men and women in wood, and throw them into the river Magdalena, from whence they issued in the shape of human beings, and that, being taught by him to cultivate the soil, they had multiplied, and dispersed themselves, and thus peopled the whole country.

Whilst Benalcazar, who acted under the orders of Pizarro, was reducing the south, towards Quito, another of the Spanish commanders was accomplishing the same object in the north part of the country. Gonzalo Ximenes de Quesada was sent in 1536 by Fernando de Lugo from Santa Marta to explore the countries bordering on the Magdalena. His greatest difficulties at first arose rather from the impenetrable thickets that opposed his passage, than from any warlike force which the savage natives, who were few in number, and of little bodily strength, could present. After ascending to the junction of four rivers, he formed an establishment, from whence, after a short interval, he continued his progress. As he advanced to the higher regions, he found the inhabitants more warlike, but much divided among themselves, whilst some, with great vehemence, opposed his passage; their enemies soon formed alliances with him, and afforded him every assistance in their power. Bogota, the greatest of the monarchs, was his most decided opponent, and collected all his force in the fertile plains of Santa Fé. A pitched battle, whose fate was not long doubtful, decided the future lot of the principal power, and by the fall of Bogota and his auxiliaries, the Spaniards and their allies were enabled to establish a durable dominion. The conquerors were rewarded with considerable booty in gold and emeralds, and if we may draw inferences from some facts narrated by their own historians, conducted themselves with both cruelty and fraud to the wretched inhabitants. Quesada lived to an extreme old age, and saw, before his death, the country he had conquered, flourishing in agriculture, in population, and in mines. Cities, towns, cathedrals, and churches were built, and the Catholic religion professed by the old as firmly as by the new inhabitants. He lived sixty years after he had completed the conquest, dying in 1597. During his long life the mixture of races had been completely effected, and those derived from the union of Spanish men with the Indian women, were making rapid advances towards an equality in numbers with the pure Indians.

As the tranquillity of the country became established, and the natives became reconciled to their new master, the arts of life from Europe were introduced; and though, from the richness of the soil, and the mildness of the climate, there were few inducements to much exertion, yet a gradual increase has been going on in population; and having no wars, either external or internal, to rouse their energies, the quiet and peaceful country has enjoyed a degree of repose unknown in any other part of the globe. New Granada has exhibited none of those mixed scenes of glory and of suffering which other countries have displayed. During two centuries and a half the furious passions have not been displayed; the whole prospect has been calm, still, and quiet; amidst the indulgence of every degree of indolence, however, this country has been gradually progressive; it has increased in numbers with considerable rapidity; in knowledge and civilization with a slower pace; but in great powers of mind, if any progress has been made, it is scarcely perceptible. Two insurrections, indeed, have happened within our time, but the power of that soporific superstition which Spain has fostered in all her settlements, with most sedulous anxiety, lulled to rest the waves of tumult, and calmed the temporary rage of the population. The particulars of these partial risings, and the narrative of the more important events, which arose out of the occupation of Spain by the troops of Bonaparte, will, with more propriety, be related, after we have described the classes of the inhabitants, and the forms of government and law, by which, since their first establishment, they have been regulated.

Different Classes of Inhabitants.

All the various classes of inhabitants in the Spanish settlements, numerous as they are, and distinguished by jealousies greater in proportion to their proximity, are derived from the three races of Europeans, Indians, and Africans. Considerable numbers of each of these races have continued, ever since the first settlement of New Granada, without any mixture with the other classes. Many families of the European race, the descendants of the first conquerors, or the more early settlers, have continued, without any legitimate intercourse with the other races, to transmit through successive generations the pure Castilian blood. These have the rank, and frequently the titles of nobility; they are the proprietors of the most extensive estates, and sometimes of the most valuable mines. Their pride is excessive, and their power over the inferior casts is exercised with considerable rigour; notwithstanding the restraints placed on their authority by the mild laws which are framed in Europe. Those whites of ancient origin, but of American birth, are very rarely trusted with any high offices in the church, the state, or the navy. The few white inhabitants of European birth who are sent by the court of Madrid to America, are in almost exclusive possession of every office of emolument or authority. The ancient nobility of America view the officers who are sent from Spain with a mixture of envy, jealousy, hatred, and disdain, but ill suppressed by the fear of the superior power with which they are invested.

The fact cannot be disguised, that a long residence in a country where the principal labour is performed by slaves and inferior casts, has a ten-

dency to destroy those fine feelings of justice, and that warm sympathy with distress, which is created by the approximation towards equality, which prevails, in a greater or less degree, throughout Europe. The white natives of America have lost the idea that a slave is a man, and consider him as a thing, a subject of gain or of loss, rather than an object of sympathy and fellow-feeling. The Indians and Negroes, and all the mixed variety of intermediate races, are too sensible of the light in which they are regarded by their white fellow-countrymen to look up to them with any other feelings than that of dread and hatred. When they want protection from injury, or redress for their wrongs, they look up to the few Europeans who are settled there to administer the government, who have the power, and are supposed alone to have the inclination, to protect them. The natives of Europe are so few in number, and so conscious of their weakness, that they endeavour to secure the affections of the Indians and Negroes by such conduct as is most adapted for that purpose, as far as it does not interfere with the principal object of their desire, that of amassing wealth, with which to return and enjoy themselves in Europe. The policy of the Court of Spain towards its American subjects is not very dissimilar to that which prevailed in Europe during the existence of the feudal system; it was then the desire of the monarchs to lessen the power of the nobles by supporting the commons, and even the peasants, against them. The ancient white inhabitants of Spanish America are a species of nobles, and these appearing to support the Indians and the Negroes who are the commons and peasants of America, gives a firmness and authority to the Court of Madrid, which it could not have retained by any other system of proceeding.

Besides the unmixed race of native whites, there are great numbers of inhabitants descended from the European men and Indian women. The first and second generation of these are considered as a degraded cast; but in the course of a few generations, each increasing in the proportion of the white blood, they come to be considered as whites, and though they scarcely attain to the dignity of the pure European race, they assume a rank in proportion to their nearer approximation to that complexion. This description of persons increases more rapidly than any other cast. Every union with a white person elevates the offspring one step in society, and hence all the various tints are ambitious of contracting matrimony with those who are whiter than themselves. The intermediate casts, after several crosses, are generally, when speaking of the mass, confounded with the pure whites, and distinguished from the Europeans by the name of Creoles. It is under this denomination we shall speak of them in the future part of this article, as it will be a sufficient distinction between them and the other casts. The proportion of the numbers of the Creoles to the other inhabitants varies in the different settlements, but in the kingdom of New Granada they bear a larger proportion to the whole population than in any other country. In the whole of Spanish America they are estimated at one-fourth, but in this viceroyalty they are considered to be between one-third and two-fifths of the inhabitants. Their wealth far exceeds the proportion of their numbers; the land, the mines, the cattle, the utensils, and the arts of industry, are principally to be found in this class; the few manufactories that have been established are conducted by them, and the Indians are employed as their workmen. The oppressions they practise towards that unfortunate race are such as no laws have yet been able to relieve them from; every salutary regulation that could be devised in their behalf has been enacted, but the execution has been lamentably defective.

The Indian races are, by the laws of Spain, declared to be freemen, and the old practices, known by the name of repartimientos, by which, under the pretext of being protected by individual Spaniards, they were, in fact, reduced to the condition of slaves, has been long abolished. Many of the Indians reside in their own separate villages and towns. They are kept distinct whilst there from the white race, and ruled by their own hereditary chiefs. The government of Spain requires from each chief an annual tax of two dollars for every individual under his government, which he collects from his unfortunate dependants, often with great severity; though that severity has been attempted to be softened by the appointment of white corregidors, whose duty it is to protect the Indians from the oppressions of their native princes. This tribute from the Indians was intended to favour rather than oppress them, as, in consideration of it, they are exempted from all other imposts. In the Spanish dominions, a most impolitic tax, called Alcavala, originally imposed by the Moors when they ruled the peninsula, is universally levied. It is six *per cent.* upon all sales of property; but in consideration of this tribute, the Indians, in those places where they are ruled by their own chiefs, are exempted from this payment.

The chiefs who rule these Indian tribes are under the superintendence of the corregidors, who are considered as their guardians; and the people, in the eye of the law, considered as minors, in a state of pupilage. They can enter into no contracts, nor do any other act, without the direction of their chief, who avails himself of this condition of their being, to enrich himself from their scanty possessions, whenever he can blind or bribe the corregidor, by whom he is controlled. Whilst residing in their native villages, these Indians can contract no marriages with the whites. The only liberty they enjoy is the power of removing from their towns to the places where no chief rules. This they can do at their pleasure, and may then hire themselves as servants or labourers for their own account. In these changes of situation, they too often only remove from the slavery of their native chief to the worse slavery of their own vicious propensities. Like all uncivilized people, they are excessively addicted to the abuse of ardent spirits; the first money obtained by labour is generally applied to this pernicious gratification. The Creoles, who know their weakness, when they wish to engage them as workmen in mines or manufactories, gratify them with spirits, till they become indebted to them in such sums as give them a power to keep them at work on their own terms, under

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pretence of extricating them from the debts they have contracted. As in these situations they have no natural protector, either in their own chief or their corregidor, as they had in their native villages, they become the prey of the Creoles, who know they are not able to procure redress from the ordinary courts of law, which are both tedious and expensive. In spite of the benevolent attention which the court of Spain has constantly given to the situation of the Indians, the lot of the general mass, though in law they are freemen, is certainly much worse than that of the Negro slaves in the Spanish dominions, or even of the slaves in the English, Dutch, and French colonies, where they are treated with more harshness than by the Spaniards.

New Granada has partaken less of the iniquity of the African slave trade, than any other division of the western world, except Mexico. In the interior, the most populous part of the country, there are few or no negro slaves. What do exist are in the towns on the coast, or in the plantations in the lower and warmer climates, where the tropical productions are cultivated. Of late years, very few have been imported; and those who were formerly brought into the country have so mixed with the other races, from the natural desire of bettering the condition of their offspring, that the number of mulattoes, quaderoons, quinteroons, and other mixtures of whites and negroes, far outnumber the unmixed blacks, and the Zambos, the race between the Negro and the Indian, are supposed fully to equal them.

We have before remarked, that the condition of the negro slaves in the Spanish colonies is preferable to that of the same class in the other European establishments. Their state, indeed, more nearly approximates to that of apprenticeship for life, than what may be properly termed slavery. They are considered by the law as persons capable of holding property, and enjoying other rights. Ill treatment from the master, or any member of his family, entitles them to manumission, without price, however highly they may be valued. When, by their economy in the time allotted them to labour for themselves, they have saved a stated sum, they may redeem themselves, though the price the master may have paid for them, or can sell them for, should ever so far exceed that amount. They are allowed two days in each week to work for themselves; when, by the labour of those days, they have saved sufficient, they may at the fixed price purchase another day, and so proceed till they have obtained their freedom. A slave may purchase the freedom of his child at a very low sum. By these regulations the number of slaves is considerably lessened, and the lot of those who are not redeemed is considerably softened. These humane regulations have been framed in Spain. They have been opposed or censured by the Creoles, and can only be put into practice by the European Spaniards, who, by acting the part of protectors to this race, acquire their confidence, and incur the animosity of their masters.

Both the Indian and negro population are carefully imbued with the doctrines of the Catholic religion. The missionaries are numerous, sober, and diligent; and, if the ceremonies of the church have no great tendency to enlighten the minds, or amend the morals, of these casts, it cannot be doubted that, by the example of more cleanliness, industry, and freedom, they must produce some good; and, perhaps the practice of auricular confession, which, in polished society, and with civilized people, begets either hypocrisy or mental debility, may, with those rude people, be made the instrument of correcting some of their grosser vices. Though the missions are scattered over the whole country, the number of priests, including both regular and secular, is far less than in the Catholic countries of Europe. The best benefices are generally filled by European Spaniards; though there have been instances of Creoles and Indians being promoted to the Episcopal chair. A great degree of animosity and jealousy subsists between the Indian and the Negro races. The latter, but more especially their descendants, the Mulattoes, view the former with contempt and disdain; and the poor timid Indians hate, but cannot despise, the Negroes and Mulattoes, whose activity and exertion is greater, and who appear to have naturally minds less degraded.

Within the kingdom of New Granada there are several tribes of Indians who are in a state of savage barbarity, or at least who have never yet been subdued by the Spaniards, among whom they are known by the description of *Indios bravos*. In the mountainous parts of the province of Santa Marta, one nation subsists called Goahiros. Their stations are between the entrance to the Gulf of Maracaybo and Rio de la Hacha, and extend near one hundred miles on the coast of the Carribean Sea. Their numbers have been calculated at thirty thousand souls. Their chief resides in a fortified town, on a hill called La Teta, some miles from the shore. They are constantly at war with the Spaniards, and are reported to receive muskets and ammunition from contraband traders who approach to their coasts from Jamaica and Curaçoa, and trade with them under the severest caution, from the apprehension of becoming the victims of their treachery, whilst engaged in this commerce. They sometimes traffic with the Spaniards of Rio de la Hacha, principally for spirituous liquors, in exchange for which they give dye-woods, horses, oxen, and mules, and sometimes pearls. It is said that this nation has subdued another tribe of Indians in their vicinity, called the Cocinas; and, after the conquest, distributed the prisoners among their own nation, where they have since continued in the condition of slaves.

Territorial Divisions.

In reciting the territorial divisions of the kingdom of New Granada, it will be better to take them according to their local position than to their importance; and therefore we begin with the northern provinces. Three provinces in the isthmus of Darien form part of the viceroyalty of New Granada; and are generally distinguished by the name of the provinces of Terra Firma. One of these, though subject to the viceroy of New Granada, is not in South but in North America; and therefore, in strictness, ought to form a part of the Presidency of Guatimala. Veragua, the northernmost part of New Granada, and the southernmost province of North Ame-

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rica, was first attempted to be settled by Columbus, in 1503; but the hostility of the natives prevented his accomplishing his design. Several successive attempts were subsequently made, and even as late as the year 1760, the whole of the mountainous district, which is by far the largest part of the province, was not subdued. The towns, or, as they designate them, the cities, built by the Spaniards, are, St Jago de Veragua, Neustro Senora de los Remedios, and Santiago de Angel. These are all in a warm, moist, and unhealthy climate, and the inhabitants are mostly Creoles or Indians. Having no sea-port, and no river navigable for any but the smallest boats, they have little commerce. The roads, too, through the whole province, are so bad as to forbid much intercourse. The industry of the inhabitants is principally applied to the production of articles for their home consumption; and these are easily procured in that fruitful soil. Maize, rice, sugar, and all tropical fruits, are abundant; and black cattle and horses are to be found in great numbers, with scarcely any who think them worth owning. Gold and silver mines exist in this province; but they are very partially worked. They are situate on mountains, from whence there being no roads, and having no water, the ore must be brought on men's backs, by which the expence becomes so great, that they scarcely can obtain their expences.

Panama. Panama is a province on a well known isthmus of that name, and has been long considered the most important province of Spain. A branch of the Andes runs through its whole length, the higher summits of which are cold and barren, but the intervening valleys, as well as the low ground, on the Carribean and Pacific seas, are rich and fertile, but on the eastern side generally unhealthy. From the centre of the ridge of the mountains of Panama the Southern or Pacific Ocean was first discovered by Balboa in 1513, and the province still continues the most easy point of communication between Europe and Peru. This route is accomplished by ascending the river Chagre from its mouth, near which is fort San Lorenzo, to the small town of Cruces, where the river ceases to be navigable. There is then an ascent by a road, practicable only for horses and mules, to the top of the Andes; an ascent so difficult that some cannon designed for Panama having been carried there, were found impossible to be removed. The distance from Cruces to the city of Panama is only five leagues, but from the acclivities, and the badness of the road, it requires twelve hours to perform it. The rapidity of the river Chagre is also a serious impediment, when it is full of water, so that this short journey frequently occupies five or six days.

Panama, the capital city, is on the shore of the South Sea, is the residence of the Intendant of the province, the seat of a royal audiencia, and the See of a Bishop. It is estimated to contain about 16,000 inhabitants, a greater proportion of whom are negroes than is usually found in New Granada. It is about a league from the shore, and has no harbour; but the island of Perico affords both secure shelter and excellent anchorage for vessels of the largest size. It is slightly fortified, and might be easily taken by any power that possessed naval superiority on the Pacific Ocean. The trade of Panama is at present inconsiderable. The treasure from Peru in indeed in some degree conveyed through it, but the facility with which voyages round Cape Horn are made, and the freedom of trade which the court of Spain extended in 1786, have reduced its commerce very considerably. It has a fishery for pearls, which is principally carried on by negro slaves. Portobello is the next place of importance, but, though dignified with the name of a city, it has scarcely any permanent inhabitants. It possesses one of the finest and best defended harbours in the western hemisphere; but, from the intense heat of the climate, and the excessive rains, it is so unhealthy as to destroy life in an unexampled degree. It is said that no person born there ever lived to 20 years of age; and this conviction is so strong, that the wives of such officers as are stationed there remove to more healthy situations to bring forth their children. When the commerce of the South Sea was conducted through the isthmus, the fair of Portobello was a great commercial mart; and this led to the attack by Admiral Vernon, whose success, though exaggerated at the time, was neither in the transaction nor its consequences worthy of notice.

The only other place of importance in this province is Nata, or St Jago de Nata. It is about 50 miles south-west of Panama, on the western side of the Andes, on a spacious bay in the Pacific. It is a large town, depending almost wholly for its prosperity on the fertility of the fields which surround it, and which are highly productive in sugar, cocoa, and indigo, whilst the mountainous districts in its vicinity abound with cattle of every description. Its inhabitants are wholly either Creoles or Indians, and their intermixtures, with scarcely a single person of the African race.

Darien. The third province of Terra Firma, Darien, can scarcely be said to belong to Spain; for the Indios-bravos, notwithstanding repeated attempts, both by missionaries and by arms, to reduce them, have maintained their independence, and destroyed the settlements that have been attempted to be formed. These Indians are the descendants of those tribes who, during the existence of the bucanneers, gave to those freebooters every assistanee they required, conducted them from one sea to the other, through ways now never attempted, and were the principal means of the success which attended their excursions. Their animosity to the Spaniards and their reclaimed Indians is still cherished; and the humidity, and consequent unhealthiness of the climate, is the powerful weapon which has defended their erratic independence. This province is principally interesting from the river Atrato running through it, by which only a ready communication between the Atlantic and Pacific Ocean can be opened and maintained. If vessels ascended this river, and a canal were cut from it to the river St Juan, which is a short distance, and through a level country, a junction of the two seas might be effected. In this province the Scottish colony, projected in the year 1695, made an abortive attempt to establish itself,—an attempt which, though it ended in disappointment and ruin

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to the parties who embarked in it, displayed considerable expansion of intellect in the projection, but not accompanied with that accurate calculation of obstacles which is indispensably necessary in expeditions of such magnitude.

Carthagena.

The province of Carthagena is the most important of the maritime districts of New Granada. On the sea coast, where the city of Carthagena, the capital of the province, stands, the climate is universally warm, and in most situations humid. Where the latter quality is found, the unhealthiness is most distinctly exhibited in the sallow countenances and attenuated muscles of the inhabitants, who are subject to malignant fevers of the most debilitating species, and whose lives, short as they usually are, are periods of sickness and debility. Notwithstanding the perpetual recruits which its population has been receiving both from Europe and from Africa, it has not perceptibly increased for the last century. The principal inducement to the first settlement at Carthagena was the security of the harbour and the strength of the military position. The fertility of the soil was soon ascertained, and in spite of its unhealthiness the country became settled, and has since, by repeated emigrations, been maintained in a flourishing condition. All the tropical productions are cultivated with success. Sugar, cotton, coffee, cocoa, and indigo, are common, and in their cultivation employ considerable numbers of negro slaves, who are, indeed, more numerous in and about Carthagena than in any other part of the viceroyalty. The city of Carthagena is the grand emporium of the central commerce of the whole of New Granada. Whatever of the luxuries of Europe are consumed in the centre of the kingdom must pass through this its only port, and though, from the difficulties of the communication, and the abundant supply of all indispensable articles which the interior furnishes, their wants are small when compared with the population, yet the transit to a whole kingdom passing through one port, must make that port the mart for considerable commerce. The interior of New Granada furnishes but few articles for exportation, but what few it does furnish can only pass through the single port of Carthagena. The number of rich merchants thus induced to settle in it is considerable, and the fortunes amassed are large; but it is observed that none of these capitals remain long stationary,—the possessors generally return to Europe to enjoy them, or remove to the more elevated and healthy situations, where they establish their families in climates favourable to longevity, and enjoyment. Before the introduction of what is called, though erroneously, free commerce, the trade of the city of Carthagena was much more considerable than it has since been. It was the port at which the galleons rendezvoused previous to their departure from Europe, and thus became a great mart to which the merchants from Lima, Guyaquil, Popayan, Quito, and Santa Fé, repaired, and met those of Europe. From thence the commodities of the old were distributed over the new world, and the precious metals shipped to be conveyed to Europe. The deposit of European goods in Carthagena is rendered very hazardous by the numerous insects, who, with remarkable voracity, destroy every thing which comes within their reach, especially all kinds of silks, cloths of linen, woollen, or cotton. One of these insects is called the Comegan, a kind of moth or maggot, but so expeditious in its depredations, that it soon reduces to dust the contents of any bale or other package on which it fastens itself. Without altering the form, it frequently perforates the covering, and with great dexterity consumes the contents, so that, when opened, it is found to contain only small shreds and dust. The strictest attention is necessary to preserve the goods from such accidents, because the insect is so small as to be scarcely visible to the naked eye, and yet so active as to destroy all the goods in a warehouse sometimes in a single night. The most effectual precaution is to place the packages in situations where they do not touch the walls of the apartment, and to raise them above the floor on stands, whose feet are placed in naphtha or tar, which these insects cannot pass over. Carthagena is strongly fortified, but military events have shown that it is far from impregnable. The principal defence of the harbours is derived from the numerous shoals at its entrance; but such obstacles are easily vanquished by the skill of able pilots, who are easily instructed, or soon instruct themselves, as our naval experience in many instances will prove. The streets of the city are broad and well paved, the houses mostly of stone, with virandas and lattices. It is the seat of a bishop, and has a cathedral with several churches and convents. The inhabitants are estimated at 24,000. The greater part are of Indian origin; the next in number are the Negroes and Mulattoes; and the white inhabitants, including both Europeans and Creoles, are a very small portion. From the security of its harbour, and its supposed importance, this city has been exposed to successive attacks, and, notwithstanding its strength, each of them has been successful.

The province of Carthagena contains no towns of much note besides the capital. The greater part of the population is scattered on distant plantations on the plains, or in small settlements on the hills, where they are occupied in breeding cattle. The most considerable town is Mompox, situated about 110 miles south of the capital, in a very healthy country, about twenty-five miles above the junction of the rivers Magdalena and Cauca. A custom-house is established there, where the dues are paid on all goods transmitted from the city of Carthagena to the interior of the viceroyalty. The inundations at Mompox are considerable in the rainy season, the waters rising from twelve to fourteen feet above their usual level. This has induced the erection of an elevated quay, on which the custom-house stands, and is both an ornamental and useful work.

The other towns, Tolu, St Sebastian, Barancas, Santa Maria, Zamba, and Gumaco, are very inconsiderable, are mostly inhabited by Indian families, who, without commerce, and with little intercourse with the rest of the world, or with each other, subsist on the productions of the fertile soil that surrounds them.

Santa Marta.

The province of Santa Marta has, by its salubrity, beauty, and fertility, obtained in New Granada the

New Granada. title of the *Pearl of America*. It is about 300 miles in length and 200 in breadth. The greater part of the interior consists of mountains gradually rising in elevation till they ascend above the limits of perpetual congelation. The valleys between these mountains are refreshed with the perpetual streams that descend and the cool breezes that blow from them, so that an everlasting spring is enjoyed by the inhabitants. The air, unlike that of Carthagena, has not that degree of humidity which generates fevers and leprosy, or that tends to shorten life, nor are they plagued with that innumerable phalanx of scorpions and noxious insects which form the misery of the inhabitants of the adjoining province. This province was one of the earliest settlements formed on the coast of the Carribean Sea. Its founder was Alonzo de Ojeda, and his authority included Darien, Carthagena, Santa Marta, and Maracaybo, which were united under one government, and then called New Andalusia. The principal city, of the same name as the province, enjoys an excellent harbour, and is fortified with considerable attention. It is the see of a bishop, has a cathedral, several parish churches, and some convents. The inhabitants are estimated at 7000 souls, who are mostly Indians or mixtures of Creoles and Indians, but there are few whites, and of them very few are natives of Europe. The trade of the port has declined considerably of late years, the greater part of it as well as that of the other port, Rio de la Hacha, having transferred itself to Carthagena. The river Magdalena is the most important feature of the province. Numerous tributary streams descend with rapidity from the mountains, which increase its volume. In their course they have worn ravines so deep, and with banks so precipitous as to render them impassable. In order to cross these ravines, temporary bridges are formed of a most peculiar construction. They stretch over the stream two cables twisted from the flexible roots of trees; they are laid parallel to each other, and stretched, by means of a windlass, as tight as their great thickness and weight will permit; over these two parallel cables, bushes, and rushes are laid to form the flooring of the bridge; two other ropes a little above these distended cables are fixed, and form a kind of balustrade. The great weight of the cables causes them to drop in the centre, and thus form a concave semicircle. When the river is wide and the wind high, this bridge is much agitated, and swings backwards and forwards, to the no small alarm, and sometimes to the not slight danger of the passengers.

Another kind of contrivance for passing these rapid streams is frequently adopted by passengers. Three or four thongs of leather are twisted into a species of rope, and fastened on the higher and lower banks of the river, forming an angle of descent of fifteen or sixteen degrees. The passenger is suspended in a kind of basket, with a grove through which the rope passes, and when loosened from the higher bank descends to the lower across the stream, with such rapidity, that the friction causes sparks of fire to be elicited from the leathern rope, and sometimes in such quantities, as to endanger the eyes of the passenger. The Indians, who act as guides over these precipices, recommend those who are thus conducted to keep their eyes shut during the flight, for such it may be called, over the precipice. These kind of machines are constructed near to each other, where the unequal elevation of the banks will admit of them; one is for going, and the other for returning from one part of the country to another. The mouth of the River Magdalena forms a Delta, which is overflowed in January and February. On this land the deposit of slime which is left creates a degree of fertility, equal to what is known in any part of the world. The productions of the valleys of Santa Marta are all the tropical fruits, especially cocoa, which is supposed to be better than in any other part of the Spanish dominions on the eastern side of America. The hills abound with cattle, many of which are slaughtered for the sake of the hides and tallow, which form a considerable part of the export commerce of the province. The whole number of inhabitants is estimated at about 280,000 souls, the far greater part of whom are Indians, though some negroes and mulattoes are found in the plantations of sugar and coffee in the lower parts of the country. The town of Rio de la Hacha is next in importance to the capital, and has the advantages of a good harbour, and a river navigable for small craft. The other towns are Cordova, Puebla-neuva, Teneriffe, Ocasia, Puebla de la Reys, and Tamalameque, none of which are considerable, or have any productions that deserve to be particularly noticed.

Merida. The province of Merida to the eastward of Santa Marta, and bordering on Maracaybo, is principally composed of a chain of the Andes, whose highest elevation is 15,000 feet, and is consequently within the line of perpetual snow. On account of the inequality of its surface, the climate partakes of every degree of variation from the extreme of heat to that of cold. The far greater part of the province is uninhabited, and the whole population is not estimated to exceed 70,000 souls. Plantations of sugar, coffee, and cocoa, are found in the lower levels, but their principal productions are raised at the elevation of from 5000 to 8000 feet, and consist of excellent wheat, beans, peas, potatoes, and maize. The cattle are abundant, and their hides and tallow form branches of commerce. Some of the most copious rivers of South America have their sources in this province, especially the Apure, which, after watering very extensive plains with the others, contribute to swell the stream of the Orinoco. Merida, the capital city, is estimated to contain from 10,000 to 12,000 souls: a great proportion of them are white Creoles, some few European Spaniards, and the rest mestizoes or descendants of whites and Indians. Besides its agriculture, which is the most considerable pursuit, it has some manufactories of cotton cloth. It is a bishop's see, and has a college or seminary for the education of the clergy. The other towns are Pamplona (near which are some mines of gold), San Christoval, and La Grita, which are scarcely deserving of any notice.

Antioquia. The province of Antioquia equals any of the provinces of New Granada in the elevation of its mountains, of which it almost wholly consists; but at the heights below the limits of congelation, some plains

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are found which unite fertility and salubriousness in the highest degree. The dew is not hurtful, and the climate so mild and equable, that the inhabitants can always sleep in the open air. It is rich in minerals, but from the paucity of inhabitants, and the want of capital, the mines are not worked to any considerable extent. What silver is produced in New Granada is chiefly from the mines of Vega de Supia in this province. Quicksilver is produced at Santa Rosa; gold in Buricota, San Pedro, and Arenas; and more than 8000 negro slaves are employed in the small villages on the banks of the Cauca in washing the sand for gold dust. The capital town, Santa Fé Antioquia, contains but few inhabitants, though it is placed in a most healthy and fruitful spot. The rest of the population is scattered over an extensive surface, far removed from each other, and have but little intercourse with the rest of even their own province.

Choco.

Choco is as thinly inhabited as any part of Spanish America, though occupying a considerable extent of coast on the Pacific Ocean, and extending from thence to the foot of the western ridge of the Andes. It contains no town whose name has reached to Europe. The heat of the climate is excessive, and its humidity makes it unhealthy. Its productions are those common to tropical regions. Choco is principally to be noticed as the country in which platina is exclusively found; it is to be met with in alluvial lands in small grains, in a district between the second and sixth degree of north latitude. No mines of it have yet been discovered; but it is highly probable, that, at some future period, when the country is more completely explored, such mines will be found, and render that valuable metal more abundant than it is at present. Gold is procured by washing the sand of the rivers at the foot of the Andes; it is usually in grains. This province has so little connection with the rest of the world, that what is not produced within it, such as iron and wheaten flour, are sold at most enormous prices. The increase of navigation on the river Atrato, which, till recently, was forbidden, will throw much light on the condition of this province, and perhaps raise it to considerable distinction. We have before noticed, that this province forms the easiest communication between the Atlantic and Pacific Oceans; and a ravine, called Raspadura, is said to have a communication through it, by which the river St Juan, which runs to the South Sea, is already in some degree united to the Astrato.

Santa Fé.

The province of Santa Fé is in every respect the most important of this viceroyalty. The whole of it is situated in the finest possible climate; a perpetual verdure covers the earth and the trees; its fertility is excelled by no soil on the globe, and it is thickly peopled. Those who have visited it have compared it to the most beautiful and most populous parts of England in the months of May and June. Wheat, barley, potatoes, apples, pears, peaches, and, in fact, all the fruits of the temperate zone, are produced with little labour, and in great abundance, at the elevation of from 5000 to 9000 feet above the level of the sea, whilst on the less elevated spots the choice fruits of the tropics are to be found. The plain of Santa Fé is an extensive district, which surrounds the capital, and furnishes its markets with every agricultural production that is valuable to the comforts of human beings. It is surrounded with mountains, but none so lofty as to be perpetually frozen. These supply rivulets, which water the plain in every direction; and the soil is evidently alluvial, collected when the plain was a lake, which its appearance plainly proves to have been formerly the case, and which the traditions of the natives strongly corroborate. By some extraordinary convulsion of nature, the barrier of mountains must have been burst; and that passage formed, by which the river that now precipitates itself by the fall of Tequendama in its descent has drained this vast plain. Few features of nature are more grand than the cataract of the river Funza, or Bogota, called by the inhabitants the Salta of Tequendama. The river, gentle and transparent, glides slowly along the plain, collecting in its course the tributary rivulets, which have descended from the hills, and fertilized the plain. It is about 140 feet in breadth near the point from whence it vanishes. It becomes suddenly contracted to the breadth of thirty feet, at the entrance of the fissure by which it escapes, and then with violent noise and agitation suddenly precipitates itself into the plain below. The descent is 600 feet, and it plunges into a dark gulf whose bottom is always invisible. It again emerges, and forms the river Meta, which runs to the Orinoco. Though at the beginning of its descent it appears a sheet of water, in the course of its fall it is broken into small particles, and alights at the bottom in the form of an everlasting shower of thick rain, whose drops obscure the prospects, and darken the lands on which they fall. The vapours which are evolved and scattered by the fall of this vast body of waters, fertilize the surrounding lands in a most extraordinary degree, so that the wheat grown at the farm of Canos, where the descent begins, is considered the best in quality, and the most abundant in produce, of any within this fertile viceroyalty. The river at one bound leaps from a temperate to a torrid region; at the top are seen the oak and elm trees of Europe, at the bottom the sugar cane, the palm tree, and the bannanas of the West Indies.

The natural bridges of Icononzo are most extraordinary exhibitions of the effects of the greater convulsions of nature. The small torrent called Rio de la summa Paz falls from the eastern chain of the Andes, and would be impassible but for these natural bridges. A crevice, probably formed by an earthquake, receives this torrent in the valley of Pandi; and within the crevice are formed two beautiful cascades; over the top of the upper cascade, the enormous rocks have been so thrown together, as to support each other on the principle of the arch. This arch, thus formed by nature, is forty-eight feet in length, forty-two feet in breadth, its thickness, in the centre, is seven feet. This bridge is about three hundred and twenty feet above the torrent, and the water, in the stream, is about twenty feet deep. About sixty feet below this, another similar bridge has been formed much resembling it; three enormous masses of rock have fallen so as to support each other; that in the centre forms the key of this

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New Granada. natural arch. The torrent appears to flow through a dark natural cavern, where arises a melancholy noise, caused by the flight of numberless birds which haunt the crevice, and appear like bats of a most unusual size. Thousands of them are seen flying over the surface of the water, and they appear as large as a fowl. It is not possible to take them on account of the depth of the fissure, and they can only be examined by throwing down torches to illuminate the sides of the crevice.

The city of Santa Fé de Bogota is the capital of the province of Santa Fé, as well as of the viceroyalty of New Granada. It is on the plain before noticed, 8700 feet above the level of the sea. The thermometer sometimes, though but rarely, descends to the freezing point, and the temperature is, in general, remarkably equable. It is a handsome well built city. It contains four squares, which are connected by wide and regular streets; two small rivers run through it, over which five handsome bridges are constructed. The public buildings are sumptuous, particularly the cathedral and the palace of the viceroy. It contains several handsome churches, eight convents, four nunneries, a royal mint, a hospital, and a university, in which several of the professors, as well as their pupils, have acquired considerable celebrity. The inhabitants are estimated at 35,000; they are, in general, in a state of mediocrity, possessing lands in the province, and some are occupied in the more common manufactories, but it is not a place of extensive trade. The country around the capital is thickly studded with farms and cottages, the industry of the inhabitants is considerable, and it is principally exercised in agriculture, by which they obtain abundant crops of every species of grain, and usually have two harvests in the year. Next to Santa Fé de Bogota, the most considerable town is Honda, which is on the banks of the river Magdalena, and is the principal port. Vessels of larger size can reach this town, than are capable of ascending higher, though the river is navigable for smaller boats to a considerable distance upwards. This place, from being the point where an alteration in the size of the vessels becomes necessary, has become an entrepot, where goods are deposited, and is the residence of some opulent merchants.

Mariquita is dignified with the name of a city, has a cathedral and a bishop. It was, when the gold mines of Bocanime and San Juan de Cordova, and the silver mines of Loxas and Frias, were extensively worked, a place of more importance than it now is, but the declension of the mines has caused the declension of the city, and the inhabitants are not now more than 1500.

San Gil is a flourishing town, principally inhabited by Creoles, but the district around it has villages wholly peopled with Indians. Socorro is another town at a short distance from San Gil; the circumstances of both are the same; they are in a healthy climate, and the population has rapidly increased. They, however, deserve notice, principally from having been the seats of the insurrections which broke out in 1781 and in 1797. The inhabitants of these districts, in the first mentioned period, rose to resist a new militia law, which was very unpopular throughout the viceroyalty. They were in confederacy with some inhabitants of the capital, who, at the same time, discovered strong revolutionary symptoms, and assembled in great crowds. As the inhabitants of Gil and Socorro advanced towards the capital, and expected its support, the Archbishop, preceded by the host, addressed the populace, and, by the influence of religion, dispersed them. Thus the people of the provinces, disappointed in their expectation of support, were compelled to retrace their steps. They were followed by some troops, who attacked and defeated them. A few were punished, and the insurrection was quelled. In 1797, similar demonstrations were exhibited by the people of Gil and Socorro, on account of new regulations in the law for the extension of the monopoly of tobacco. The plan was better projected, and was rather combined with the new principles of government which had recently been developed in France, and which some of the younger men had imbibed. It was, however, counteracted by the vigilance of the viceroy, and, without any serious tumult, was suppressed. The revolutionary leaders were either imprisoned or made their escape; of the latter many repaired to France, some to the United States of America, and some to England, and from thence were afterwards collected by General Miranda, the subordinate agent employed by him to revolutionize Spanish America. They composed a part of the force with which he landed at Coro, in his ill-timed and unfortunate expedition. The population of these towns has exhibited an increase equal to what has been remarked in the most rapidly rising districts of the United States of America, having doubled twice between the year 1781 and 1811.

The other towns are, Velen, Mazo, Leiva, Villa de Purificacion, Tocaima, and Tunja, all of which, though rapidly increasing, are of less account than the villages filled with agricultural inhabitants, which cover the better portions of this province.

The province of Popayan was very early settled, Popayan. and the descendants of the first settlers have remained fixed there. The proportion of noble families is greater than in any other part of America. Though many of these are reduced to poverty, they have not relaxed that pride which was the distinguishing characteristic of the old Castillians. The privilege of wearing a sword is one of which they are extremely tenacious; and it is not even now unusual to see in Popayan the proprietor of an hereditary estate, derived from the first conquerors, but diminished to a fraction by the misconduct of its successive owners, employed in cultivating his own field, with a sword at his side, as evidence to every passenger of the nobility of his origin. The province of Popayan is both healthy and fertile; and though it has no access to the sea, no intercourse with Europe, and very little external commerce, it has increased in population with a rapidity unexampled, except in the United States. The climate is mild and equable, storms are of short duration, and earthquakes are less known than in other portions of the presidency of Quito, of which this province makes a part. Such is its ex-

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cellency, that, "As good as the sky, the soil, and the bread of Popayan," has become a proverb in the kingdom of New Granada. Wheat, maize, and barley, are abundantly produced; and, in some of the deeper valleys, sugar and coffee, whilst the numerous herds of cattle furnish a cheap provision, and supply abundance of hides and tallow for domestic consumption, as well as for the neighbouring provinces. One vegetable production of considerable importance is grown extensively in this province. The Cuca or Coca grows on a weak stem; like the vine, it requires support from some more sturdy plant, around which it twines itself. Its leaf, the valuable part, is an inch and half in length, and is chewed in the same manner as the inhabitants of India use the betel. A small portion of calcareous earth is rolled in the leaf of the Coca, and, carried in the mouth; it produces heat, and excites a copious flowing of saliva, which is swallowed, and thus assuages the excessive thirst which the inhabitants endure in passing the lofty and arid mountains. The natives attribute to it the most nutritive and invigorating qualities; and affirm that they can labour with no other sustenance during several successive days. Whatever may be its qualities, the estimation of it may be inferred from its having been, even before the establishment of Europeans, an article of considerable commerce. It is carried to all the mining districts, and the masters provide themselves with a considerable store of it, without which they could procure no labourers; nor, as they affirm, would the labourers have sufficient strength to execute their severe work, without its invigorating use. In some of the southern districts, a gum exudes from the trees, called mopa-mopa, from which a varnish is made, transparent, and so durable as to be indestructible by boiling water, or even the strongest acids. It is applied to cabinet ware, and the superior kinds of furniture, and gives to them a beauty superior to any which India or China can produce. The roads in this province are generally bad; but the intercourse between Santa Fé and Popayan is carried on by means of so singular a nature, that, without the recent visit, and the detailed description, of that excellent traveller, Baron Humboldt, it would scarcely be credible. It is necessary to cross the central ridge of mountains, by a pass called Garito de Paramo. This pass is 11,500 feet above the level of the sea, and is consequently above the line of perpetual congelation. The mules which convey goods, and even passengers, over this ridge, are frequently destroyed by the severity of the cold; and the road, for leagues, is covered so thick with their bones and frozen carcases, that it is difficult to avoid treading on them. The road, or rather track, passes through an uninhabited forest, which occupies, in the most favourable weather, ten or twelve days to pass it. No habitation is to be seen, nor any provisions to be found; so that the traveller is compelled to carry at least a month's subsistence, to provide against the impediments which the sudden showers or swellings of the streams may oppose to him, and which often protract his journey till his food is exhausted. The path through the upper part of the pass is not more than two feet in breadth. It is a kind of deep gully, at whose bottom is a thick and tenacious mud. It is so deep, that, from that circumstance, and the great number of vegetable substances which cover the top, it is almost totally dark. Some of these natural ravines are more than a mile and a half in length. The oxen and mules have the greatest difficulty in forcing their way through the deep mud. Few greater embarrassments can occur than arise from the meeting of travellers in these horrible crevices. Sometimes the sludge is so deep as to cover the backs of the animals; and, in some cases, they are even obliged to drive in the oxen, and to make a kind of bridge of their suffocated carcases. The roots of the bamboos, which are studded with hard and short prickles, and project into the path, contribute no inconsiderable share of the miseries of these dreadful passes. In this journey, especially, the better class of people are carried on the backs of men, harnassed and accoutred for the purpose. Besides their human load, these men carry a roll of leaves of the Vijao, of which to construct the nightly habitations of the party. These leaves are two feet in length, and a foot and half in breadth; and, being covered with a down, from which the rain runs off, they make good temporary roofs to the huts, whose sides are formed at the resting place by cutting a few trees, and inclining them to each other. The common price for the conveyance of the living load through this pass of horrors, which occupies from twelve to twenty days, is from ten to fourteen dollars, which, notwithstanding the cheapness of provisions, seems to be a very slight recompence for the labour and danger. There is, however, another pass, less terrific, though the danger from cold is greater. It goes by the sources of the Cauca and the Magdalena, between two summits called Coconoco and Houila, whence, if the carrier of goods is nearly benighted, he deposits his goods, and descends, lest he should be frozen to death, by the excessive severity of the cold.

The city of Popayan is large and well built, the streets are broad, and cross each other at right angles. The public buildings are numerous and handsome; it is a bishop's see, and contains, besides a magnificent cathedral, several parish churches, four convents, two nuneries, and an hospital. It had formerly a college under the direction of the Jesuits, but now governed by the secular clergy; the number, as well as the talents of the professors, has declined since the expulsion of the order; inferior studies only are prosecuted, and inferior degrees only conferred. Those who wish to attain higher distinction in the learned professions now study and graduate at the universities of Quito or Santa Fé. There is a mint here for coining gold and silver, but the produce of the mines is so small, that the expence of the establishment of the mint nearly equals the amount of the royal fifth. The inhabitants are estimated at 25,000, the far greater proportion of whom are either white Creoles, or mixtures derived from the European and African races, with but little of Indian blood. There are more than sixty noble families here, who have remained uncontaminated by alliance with the inferior colours, as they affirm, and on which they pride themselves excessively; though

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others assert, that few of these families are exempt from the Indian colour. It is, however, an aristocracy of a peculiar kind, and perhaps partakes less of the benefits of that institution, than is derived from it in our own and some other countries. Though the city of Popayan contains but few Indians, yet in the whole province they far outnumber all the other races together. Whole villages, very populous, contain no inhabitants besides them; and in the mines, that labour, which, at an early period, was performed by negroes, has devolved on them; whilst the Africans, from the paucity of late recruits, have gradually mixed with the other races, and become extinguished in the casts of mulattos, quadrons, quinteroons, and similar denominations. The river Moline rises in a mountain near the city, and passes through it; sometimes it overflows its banks, but generally for a short period; it has two handsome stone bridges built over it. Its water is considered as highly salubrious, possessing some medical virtues, and being also pleasant to the taste.

The next town in population after the capital is St Juan de Pasto, a bishop's see, and chief town of a district, to which it gives name. It contains 8000 inhabitants, mostly Creoles and Indians. The other towns are Carthage, Ibague, near which is the quicksilver mine, Cali, Timana, Neyva, La Plata, and Mercaderes; nothing remarkable distinguishes them except the rapid increase of their population; but even in this respect they are excelled by the numerous small villages, where the enjoyment of ease, and plenty, a fine climate, and moderate labour, unite in producing a vast increase of the numbers of the people.

San Juan de Llanos.

San Juan de Llanos is the eastward province of the viceroyalty, and one of the most extensive. It consists principally of plains, whose limits have not been defined, and scarcely ever explored. It is the country in which those great rivers rise, which contribute to form the immense river Orinoco. The Meta, Vechada, Casanare, and Guaviare, issue from the Cordilleras in the eastern division of this province. The climate is generally warm; the inhabitants are few, and those mostly Indians, who, in spite of the numerous missions established among them, care little for the religion or the laws of the Spaniards, but employ themselves in hunting the cattle, which, in herds without number, cover the plains. There are but two towns, dignified indeed with the title of cities, in this extensive province; San Juan, and San Joseph, the former containing about 1000, the latter 500 inhabitants. Colonies or missions were founded by the Jesuits, who certainly possessed, in an extraordinary degree, the power of conciliating the savage inhabitants, and civilizing them up to a certain point. With the dispersion of these missionaries, and the transfer of their undertakings to other orders of ecclesiastics, the civilization of the Indians here, as in other parts of America, has declined, and they are now little, if at all, removed from their pristine barbarism. The geography of this province was totally unknown in Europe before the recent travels of Humboldt, who has surveyed and mapped it with great accuracy.

Tacames, or Atacames.

Tacames, or Atacames, is a province on the Pacific Ocean, lately erected into a government; it is a narrow stripe of land, bounded to the eastward by the Andes. The productions and climate are those of the tropical regions. Its inhabitants are very few, mostly of the Indian race, though some Spanish noble families have extensive possessions. Maldonado, head of one of the principal of these families, opened a road from the river of Emeralds, which bounded his possessions, to the city of Quito, for which he was rewarded by receiving the appointment of governor of this district, which was erected into an intendancy for that purpose. The river of Emeralds was, however, forbidden to be navigated, from the facilities which it was supposed to furnish to the contraband traders; and the province, which, whilst Maldonado lived, was rapidly increasing in wealth and population, has retroceded and become insignificant. The principal place is San Mateo the capital, which does not contain 500 inhabitants, and the other towns, Tumaco, Tola, and La Cauca, are still more inconsiderable. The other places scarcely deserve the name even of villages, but are either plantations or fishing stations.

Quito.

The province of Quito has been generally placed in the kingdom of Peru, but ever since the year 1718 it has formed part of the kingdom of New Granada, and, indeed, must be considered one of its most important divisions. It is a country very various in its climate, soil, productions, and aspect; and besides Chimborazo, it includes, within its limits, all the loftiest mountains of America. The whole of Quito, sometimes called a kingdom, but more correctly a presidency, is governed by an officer under the orders of the viceroy of New Granada. The seat of his government is the city of Quito, built as early as the year 1534, on the scite of an ancient town, in one of those beautiful plains, which, in the torrid zone, are to be found on the top of the lofty mountains. These plains possess fertility, beauty, mildness, and salubrity, and produce, almost spontaneously, every thing that mankind can want. This is eminently the case of Quito and the district that surrounds it; but it has natural horrors, which, if not familiarized, would be sufficient to destroy all enjoyment. In every hill that surrounds them, its inhabitants may justly dread that a volcano will burst forth; and every day they live, they may be alarmed with the apprehension, that an earthquake may swallow them up, or bring an inundation that shall drown them. Amidst all these surrounding threats of destruction, however, and the experience of past events to alarm them, the inhabitants are the most gay, lively, dissipated, and luxurious of any people in the American continent. The population is estimated at 70,000; many are of high rank, and enjoy great wealth: the descendants of the first adventurers affected this place, and established their families in it; and their descendants, ennobled by the Court of Madrid, shine in all the gaudy finery, which wealth, without taste, can display. About one-sixth of the inhabitants are whites, but mostly Creoles; one-third are a mixture of whites and Indians, one-third are unmixed Indians, and the other sixth various casts between Indians, negroes, mu-

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lattos, zambos, all of whom very proudly boast their nearer affinity to the white race, than that of the colour, but one degree farther removed from that distinction. There is a university in which the higher ranks are instructed, and, though the bigotry and superstition which prevails through Spain and her dominions fetters the mind, and prevents it from expanding to any great extent; yet the system is at least not worse than that which prevails in the country from which the government sprung, and far better than would have been enjoyed, if America had never been visited by the natives of Europe Classical knowledge is pursued with that languid pace, which is to be expected, where every thing is measured by its relation to the degrading superstition that prevails. The exact sciences, notwithstanding their tendency to produce doubts respecting many dogmas, appear to have met with fewer obstructions; and hence mathematics have been prosecuted more ardently and more successfully than any other branch of learning. More progress has, however, been made in botany than in any other study; and the priests, who do not fear that the pursuit will stagger their faith, have pursued it with avidity and with considerable success. What is called philosophy in a Spanish university is beneath contempt, but the divinity is a study of a still lower cast, consisting of such inquiries and speculations as are revolting to common sense, and not unfrequently to common decency; for the immaculate conception is there as in Spain a test of orthodoxy, and scrupulously investigated. The universities of Quito, for there are two, have produced no scholar whose name has reached Europe, except Don Pedro Maldonado, whom we have before noticed as the governor of Tacames. He was a profound mathematician; he had pursued with avidity the study of physics; and would have been a blessing to his country, could he have resided there free from the fetters of the priests.

The city of Quito is in a narrow gorge, where two beautiful plains are connected together between high mountains. This necessarily destroys the symmetry of the form of the city, contracting it by the mountains in some parts, whilst it is extended in undue proportion in others. The high mountain Pichinca adjoins the city, and, indeed, a part of the city may be said to be built on its lower side. It rises about 6000 feet above the level parts of the city, and 16,000 above the level of the sea. Its extreme summit is covered with eternal snow, and supplies rivulets by its melting, which water the plain, and dispenses to the inhabitants the luxury of ice in the warmest seasons. In ancient times it was a tremendous volcano, but its eruptions have ceased, and it now discharges neither fire nor smoke, but at frequent periods rumbling noises issue from the crater, which call to mind the devastations its fiery streams formerly occasioned, and give to the inhabitants notes of fearful alarm. The principal square of Quito is a magnificent pile of building; the whole of one side of it is filled with the cathedral church, the other by the episcopal palace. The other two sides opposite to each other are occupied by the Caza de Cabildo, or town hall, and by the hall of the royal audience, public buildings thus forming the whole, with a beautiful fountain in the centre. There are two other squares, and the streets are numerous and wide, but, from the acclivity of the ground on which they stand, very irregular. This irregularity prevents the use of carriages, and the people of rank are carried in sedan chairs. Besides the cathedral, which is most sumptuously ornamented and adorned with images, covered with jewels, altars of pure silver, and candelabras of gold, there are seven parochial churches, various chapels, eight convents, five nunneries, and two hospitals, which are magnificent buildings, and give an appearance of grandeur to the whole city. There are no theatres, but the inhabitants are indulged with numerous processions, which are intended to be of a religious nature, and were introduced under the pretence of appeasing the Deity, and thus restraining the force of that elementary war which, from their volcanic position, they have reason to dread. These processions, accompanied with all the parade that rich dresses, gilded images, and gold and silver church furniture, can afford, pass through the streets, whose inhabitants decorate their houses by exhibiting their most costly ornaments and dresses, whilst thousands of Indians join the procession, and accompany it with their native music and dancing, to the delight of the silly and the contempt of the wiser part of the citizens. There is little commerce in the city; the numerous offices of government, the courts of law, and especially the church, furnish callings to those who have what is there considered a liberal education, and trade is too degrading for such persons. There are some manufactories, however, both of cotton and of baize, but they are of inconsiderable extent, and conducted without either spirit or skill. The workmen in jewellery are considerable, and the number of silversmiths is great in proportion to the population, as every man, above the vulgar, is furnished with silver forks, plates, spoons, and other domestic utensils, and decorates his horses with silver bitts, buckles, and stirrups.

The fertility of the surrounding district equals, if it does not exceed, the best portions of Santa Fé, and may be traced to the same causes,—the alluvial and volcanic nature of the soil, the facility of irrigation, and the equable temperature of the climate. The progress of vegetation is constant and uniform through the whole year. Whilst some plants are fading, others of the same kind are springing up, and whilst some flowers are losing their beauty, others are beginning to bloom; when the fruits have gained maturity, and the leaves begin to change their colour fresh leaves, blossoms, and fruits, are seen in their several gradations, on the same tree. The same circumstances are exhibited in the several grains: as sowing and reaping are carried on at the same time. The corn recently sown is springing up, that which has been longer sown is in the blade, that longer is in blossom, and some fit for the sickle, thus exhibiting, on the declivities of the mountains, all the beauties of the four European seasons within one view.

The breeding and fattening of cattle is conducted with equal facility, and the beef and mutton brought to the market of Quito is very good. The produce

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of the dairy is equal to that of the best parts of Europe; butter is abundant, and the quantity of cheese, made beyond what the wants of the inhabitants require, is so considerable as to form one of the chief branches of their commerce with the warmer districts. Though thus favoured with all the productions of the temperate zone, Quito is far from being destitute of the fruits of the tropical climates; in the valleys oranges, limes, and lemons, grow abundantly; and the plantains, bananas, sugar-canes, melons, and guavas, are cultivated with very great success and little labour. They make from the maize, by fermentation, a species of beer of an intoxicating quality, to whose excessive use the Indians are addicted, whilst the sugar-cane produces, by distillation, an inferior kind of rum, which is too abundantly consumed by the higher classes, who prefer it to the wines of Peru. The mineral riches of the province of Quito are but small, few mines are worked, and those have only commenced lately, and give no favourable prospect of success. Some mercury has been found, and from the name Azogue, being that of a village near Cuenca, it is supposed a mine of that mineral in former times was worked there. Quito is celebrated for having been the spot chosen by the corps of Spanish and French mathematicians, who were occupied in measuring a degree of the meridian in 1736, and the three following years. The sufferings they endured in the progress of the operation were severe, and might have been avoided by executing the experiment on some of the level and extensive plains to the eastward of the Cordilleras.

Within the presidency of Quito are several considerable towns and populous villages. San Meguil de Ibara, which stands on a high cultivated plain, contains a population of 10,000 persons. It is somewhat warmer than Quito, which causes the productions to approach nearer to those of the tropics; it contains a church, a college, and a nunnery. The most striking natural curiosity is the valley or fissure of Chota, 4900 feet in depth, always covered with luxuriant vegetation. Olabalo is thirty miles north of Quito, and somewhat colder. The population amounts to 15,000, mostly white Creoles; but the populous villages that surround it are chiefly peopled by Indians. In some of these villages are numerous tumuli, the burying places of the ancient inhabitants. These have sometimes been perforated for the hidden treasure they were supposed to contain, and, though the reward has usually been inadequate to the labour, they have discovered, among bones and skeletons, idols of gold and jewels, drinking vessels of earthenware, tools of copper or stone, with mirrors of obsidian and polished flint. Latacunga contains about 12,000 inhabitants, and, though it has been the frequent victim of the convulsions of nature, it has always risen from its ruins, and soon assumed a flourishing appearance. Being in a colder climate than Quito, the character of its productions are conformable. Large quantities of cheese, butter, and salted pork, are sent from hence to Guyaquil, and cloth and baize are manufactured to a moderate extent. Riobamba has been rebuilt since the tremendous catastrophe of 1797, in what is considered a more secure spot; and its population has so increased, as now to amount to 20,000 persons. It contains two churches, four convents, two nunneries, and a hospital, and carries on a considerable traffic with Guyaquil, for wheat, maize, and salted meat. Hambato, a town of 10,000 inhabitants, has suffered much from the convulsions of its neighbouring volcano; but, like Riobamba and Latacunga, has soon recovered, been rebuilt, and quickly peopled. In proceeding southward from Quito, the plains about Hambato and Latacunga are the first places in which the Llamas or Peruvian beasts of burden are found. These animals, whose native place is the high mountains, cannot endure a warm climate; and as some deep and warm valleys intervene betwixt this district and Quito, which they would never voluntarily pass, they are never seen in a wild state to the north of it. In Riobamba they are the common beasts of burden, and so general, that few even of the Indians are without one or two to carry his baggage and goods, when he has occasion to travel from one place to another.

The next portion of the presidency of Quito to be noticed is the city of Guyaquil, and the district that surrounds it. The city is the most important commercial place in the Pacific Ocean in the whole of South America, and more ships are probably loaded there for Europe than in all the ports of Peru and Chili. It is in latitude 2° 12′ south, and 79° 6′ west longitude. The river, of the same name as the city, is navigable for small vessels as high as Babahoya, but ships of more than 250 tons burden cannot even ascend to the city, but must have their cargoes sent down by balsas, a species of raft of singular construction, which are peculiar to this part of the South Sea. These balsas are constructed of very light logs of wood, the number of which is uneven, and the centre one longer than the others; these are lashed parallel to each other by strong ropes of bejuco, but not so close as absolutely to prevent all access of the water between the logs; by means of sliding-keels, which descend or ascend as the direction of the balsa may require, they are enabled to turn to windward, to bear up, lie to, or to steer large as well as any vessels whatever. Such is the buoyancy of the trees from which the logs are framed, that they rise and fall with the waves, and scarcely ever damage the cargo by admitting water between the opening of the logs. These balsas are evidently of Indian contrivance, and better adapted to the peculiarities of the navigation of this coast and river, than any vessels that the Europeans have invented. The country on each side of the river Guyaquil is subject to considerable inundations, which, though they render the soil fertile, tend to make the country extremely unhealthy, and to crowd it with the insects, reptiles, and amphibious animals most noxious to man. Fevers and leprosies prevail extensively, the rivers swarm with alligators, the air is filled with musquetos, and the land pestered with snakes of all descriptions. In spite of all these impediments to enjoyment, the attraction of wealth has drawn to this district a considerable population, who overlook its inflictions in the pursuit of the riches they seek. The principal article of export is cocoa, which amounts to about 45,000 quintals annually, though of late years the

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cultivation and consequent exportation of it has very considerably increased. The imports, consisting principally of articles of luxury from Europe, have usually amounted to double the exports, and the balance has been paid in the precious metals obtained by exchange from the mining districts. It has been declared to be a royal dock, but few ships of war have been yet constructed, though the size and qualities of the numerous trees which grow would be most admirably adapted for that purpose. There are many trees of a kind resembling the teak of India, and, like it, neither subject to be injured by worms or the rot. The city of Guyaquil itself contains about 24,000 inhabitants, but the district around it is very populous, containing towns such as Baba, Daule, and others, of from 4000 to 5000 inhabitants, and thickly established villages, which are filled with a Negro and Indian population. The buildings are mostly of wood whitened with calcareous earth, and hence it has been subject to great conflagrations; but the new houses being forbidden to be covered with thatch or shingles, they have not of late suffered from that calamity. The streets are broad, well paved, and the houses have piazzas, which afford to the passengers shade from the vertical sun. The public buildings are very splendid, consisting of two churches, three convents, a hospital, and a college, which was founded by the Jesuits. The town-hall is the best of the public erections, being established within a recent period. The city of Cuenca contains 20,000 inhabitants, and the fruitful plain on which it stands maintains an equal population; being higher than Guyaquil, it is not subject to many of those circumstances which produce discomfort; it is tolerably healthy, and has few venomous reptiles or insects. Its productions partake rather of the nature of the tropical than the temperate zone, and it has some manufactories of cotton and woollens. It contains three churches, four convents, two nunneries, and had formerly a college of the Jesuits. The population is mostly of Indian origin, with a mixture of European blood, but there are few if any natives of Europe established in it. Loxa or Loja is a city of 10,000 inhabitants, among whom are some noble families. It is somewhat more elevated than Cuenca, and is still more healthy; it is principally to be noticed from its being the district in which the greatest quantity and the best kind of the bark is found. The Indians cut down the trees, strip off the bark, and, after drying it in the sun, pack and prepare it for exportation. The cochineal insect is found in the district of Loxa, but as the inhabitants take little pains to propagate or preserve them, the quantity collected is barely sufficient for the consumption of the dyers of Cuenca, and none is exported.

Jaen de Bracameros.

The province of Jaen de Bracameros is to the southward of Quito, and eastward of Peru. Its capital, Jaen, contains about 4000 inhabitants, mostly a mixture of Europeans and Indians; in the rest of the province, there are few of any other than the unmixed Indians, some of whom are in subjection to Spain, but more are in their savage state. It is principally to be regarded as the district through which, when South America shall be fully peopled, a connection between the eastern and western side of the Continent may be maintained. In the present state, when the greater part of the natives live a migratory life, the scarcity of a fixed supply of provisions forbids extensive intercourse, but as all the rivers of Jaen run into the Lauricocha, or by other channels to the Maranon, it is the most easy passage from the Pacific Ocean to the Atlantic. The communication is now carried on by the post down these streams. The carrier of the letters securing them on his head, plunges into the stream, which carries him along, whilst he occasionally rests himself on a tree, of the bombon species, which he carries with him, and which is lighter than cork. In this way he passes the rapids, and finding such provisions as the huts of the natives afford, or as the chace may yield, he carries the correspondence with safety and dispatch. The climate of Jaen is generally unhealthy, and from the nature of the population and their wandering life, there can be no productions to create commerce, though tobacco, if it were cultivated to the extent it might be, would enrich the province vastly.

Maynas and Quixos.

The two provinces of Maynas and Quixos may be described at the same time; they are both at the eastern foot of the Andes, and, without defined limits, stretch across the Continent till they unite with the Portuguese dominions in Brasil. The wandering tribes, that are scattered over these immense plains, have never been subjected to European dominion, and have no disposition to be reconciled to it, notwithstanding the efforts of numerous missionaries have been directed to that object. The tributary streams of the Maranon, or river of Amazons, intersect these provinces in every direction. Streams with which the mightiest rivers of Europe will bear no comparison, unite together at various positions, till they at length form that vast magazine of water, which empties itself into the Atlantic Ocean under the Equinoctial Line. It is now clearly ascertained that in one branch of the Rio Negro there is a junction between the Orinoco and the Amazons. This river rises a little to the north of the Coqueta, and, after a very long course, divides into two rivers, one of which runs to the Orinoco, the other to the Maranon, thus providing an internal navigation to be used at some future period when the provinces of Caraccas and of Guyana shall be more fully peopled.

The river Maranon is the most remarkable object in these provinces. On every side during its protracted course it receives numerous tributary streams, which, in the quantity of water they contribute, far surpass any of the rivers of Europe. The most remarkable of these are the Lauricocha, the Beni, the Madera, and the Negro, which join it in this province; and the Apurimac, which, near the city of Arequipa, almost at its source, raises itself to the importance of a great river. Its waters run the space of 4500 miles, and it is supposed that ships of 400 or 500 tons burden might navigate it for that distance. It passes through the Andes, in 13^{0} 10′ south latitude. The pongo, or strait through which this river passes, is one of the most singular natural curiosities of the district. It is suddenly contracted from 1600 to 600 feet in breadth, and rushes with tremendous force, between stupendous

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perpendicular rocks, which form a crevice eight miles in length. When M. Condamine passed this fissure, he was carried with an impetuosity that terrified him, till he suddenly emerged into an open and extensive lake, from whence, owing to the force of the current, the possibility of his return was prevented. The breadth and depth of this vast river are every where correspondent to its length. At Coari, where it is one mile and a half in breadth, Condamine could find no bottom with a line of 100 fathoms. At the straits of Pauxis, 200 leagues from its mouth, the tide is perceptible by the rising of the river; but such is the quantity of water that rushes to the sea, and such the impetuosity of its course, that no salt water enters the river; and, on the contrary, the fresh water enters the ocean in such a volume as to displace the salt water, and it has been taken up in a drinkable state at 250 miles from the shore. By an estimate, founded on the actual measurement which Condamine made for more than 1800 miles of its course, it will appear, that, in the 4500 miles which it runs, its whole descent is about 290 feet, and that the descent from the part in which the tides are first visible is 90 feet to the sea. It is subject to most extensive floods, which inundate the country to a considerable distance from its banks during the periodical rainy seasons; but the fertility communicated by it more than compensates the temporary inconvenience.

These two provinces can scarcely be said to possess any towns; for in Borja, the capital of the one, there are few inhabitants, though it is the residence of the governor; and Archidona, the capital of the other, has not more than 700 inhabitants. There are, however, a considerable number of missions scattered over the face of the country, whose names are to be found in the maps, but whose residents are fluctuating and never numerous.

Population of the whole Viceroyalty.

It is not easy to attain accuracy in calculating the population of a country, in which are such numerous tribes of wild and uncivilized or half civilized Indians. The only estimate that can approximate to accuracy is founded on the ecclesiastical returns of the numbers that come to confession; and the result of that estimate gives to the whole viceroyalty of New Granada a population of 2,200,000 souls.

Origin of the late Wars.

It is scarcely possible to convey correct ideas on the subject of the late wars which have raged in New Granada, and in the other parts of the Spanish transatlantic dominions, without slightly viewing the causes which produced them. These provinces had long enjoyed tranquillity. The orders of the council of the Indies had been obeyed without hesitation, and without examination. They had suffered many privations from the wars in which the mother country was involved, but they had borne them with patience, and with unwavering loyalty. When Bonaparte, having kidnapped the royal family of Spain, appointed his brother to the throne, one of his first measures was to fill the council of Indies with his creatures, and issue orders to the different governments in America, announcing the change of family, confirming in their offices all the men who filled them, and announcing flattering promises of his care and attention to the well-being of the provinces. Before, however, the French vessels, destined to the different quarters with these dispatches, could be ready to sail, the spontaneous movement of the whole kingdom of Spain gave a different aspect to the state of affairs. Reports from all quarters reached various parts of America, and conveyed information of the opposition which universally prevailed to the measures of the imperial despot. In some parts the impulse was immediately communicated from the people to those who governed, and Ferdinand was proclaimed king amidst universal acclamations. In some parts those who were in possession of power hesitated what part to take, but they, too, were soon compelled to yield to the general wish. From the first arrival of the European intelligence, a marked difference was to be seen between the animated frenzy with which the Creoles proclaimed Ferdinand, and reprobated the French, and the cold and dubious manner in which the European Spaniards uttered the same language.

The viceroys and the other officers of government who had been appointed from Spain, though they all viewed the French domination with abhorrence, were apprehensive that, if the peninsula was subjected to the Corsican dynasty, and the intercourse with the colonies should be interrupted, their offices, if not abolished, would become less lucrative, and less authoritative; and that, at all events, they should be prevented from returning to Spain, to enjoy those large fortunes which they had acquired, or which they anticipated. The Cabildos of the corporations, composed principally of native Americans, felt that America was every thing to them. They had no thoughts of residing in Spain; and though they might not wish to have their parent state subdued by a foreign conqueror, yet, when placed in the alternative of either submitting to France, or breaking all the links that connected them with Spain, they could not hesitate to embrace the latter, which they did not consider as a good, but the least of two evils.

The views of the different parties were known to each other, though all united in vows of fidelity to Spain, of allegiance to the imprisoned monarch, and especially of eternal attachment to the religion they professed. The Negroes and Indians remained quiescent. They were told, that the French would rob them of their religion; and, as the value they set on that was equal to their ignorance of its nature and foundation, they were ready to receive every impression unfavourable to that nation, and to unite as far as they were able in opposing all change.

From the end of the year 1808, till the beginning of 1810, the Central Junta held rule. It was, however, found to be unfit for the government of the peninsula, and utterly incapable of directing the more distant affairs of the colonies. They knew some heats existed there, if not discontents; and, instead of a practical investigation, to which, indeed, they were incompetent, they issued abstract declarations of equality, which were of no other use but to be brought forward at a future time, in opposition to themselves or their successors; or as furnishing stimulants to the Negroes and Indians to rise against both the Europeans and the Creoles. This declara-

tion of equality, whatever was meant by it by the Junta, was by no means acceptable in America. The Spaniards and the Creoles, though most virulently opposed to each other, were equally opposed to a decree which, if interpreted according to the letter, gave equal rights and equal power to the degraded castes as to their own class. Even those of the mixed races, who approached nearest to the whites, felt indignant that those a little darker than themselves should be advanced to an equal rank.

Whilst these feelings were rankling in the minds of all parties in America, when no authority from Europe expressed any opinion, but a wish for remittances, and when no party in America was sufficiently cool to suggest practical remedies, the intelligence arrived that all was lost in Spain, that the French had overran the whole Peninsula, and all authorities there had at length submitted. Such were the exaggerated reports which generally prevailed, and remained long uncontradicted by any authority. The port of Cadiz, the only one remaining to the fragment of the government, was shut, to prevent premature intelligence; and, from this precaution, every report reached America with additions of disasters, acquired at every stage in its circuitous route. It is not, then, wonderful that, throughout America, the impression became general that they must henceforward depend on themselves alone, and endeavour to adopt such measures as should most effectually prevent them from falling under the dominion of the French ruler of Spain.

In Mexico and in Peru, the Europeans were sufficiently powerful, or had sufficient influence, to cause a suspension of independent measures; but, in every other part, assemblies actuated by fear, by fury, and by love of novelty, met and tumultuously chose delegates, who assumed the sovereign power, but exercised it in the name of Ferdinand. When these assemblies met, they had no previously settled principles, and no practical plans. They soon became involved in difficulties, and different parties had recourse to arms. The opinions and feelings of some towns in each province differed from others; and military invasions of each other were adopted, to settle the points in dispute. The whole of the provinces were in arms, and had assumed a semi-independence, before a new body in Cadiz was announced to them as the acknowledged legal government of the small portion of Spain which yet remained unsubdued by the French.

Progress of the Revolutionary spirit.

Previously to the entering of the French troops into Andalusia, and the dispersion of the Central Junta, the heats which prevailed in South America had been smothered; but the intelligence of that transaction caused the flame instantly to burst forth, and with perhaps more fervour, from having been long suppressed. This irruption took place in January 1810. Caraccas, as the nearest place to Europe, first received the intelligence. It had been almost the only portion of South America which had held much communication with England, and with the United States of America. It had, from that communication, imbibed a more free spirit, and had among its inhabitants more men who had speculated on political subjects. In April 1810, the occupation of Andalusia was known in Caraccas, and immediately turbulent assemblages were convened in the capital, who, with little care in the selection, appointed a junta to "preserve," as they stated, "the province for their king, to protect the Catholic faith, to repel all the projects of the French Emperor, and to preserve an asylum for such Spaniards as should prefer freedom in America to the slavery and irreligion which France dispersed in Europe." This Junta was composed almost wholly of Creoles; and, as soon as they were installed, and in possession of undefined power, they seized the viceroy and the judges of the royal audience; and, without trial, and with little ceremony, transported them to the United States. With a haste characteristic of such assemblies, they instantly decreed the abolition of the most efficient taxes, and thus destroyed the whole revenue, whilst they increased the expenditure, by arming the population, and left themselves no resource but confiscation and proscription, to which they speedily had recourse. Though the Junta of the capital thus assumed sovereign and independent power, and acted upon that assumption as far as they could in their decrees, yet several of the provinces refused to submit to the overbearing authority of the capital. Cumana, the second city in wealth and population, chose a Junta for itself, and refused to act with the capital, except upon terms of equality; whilst Maracaybo, Valencia, and Coro, absolutely refused to join them, and resolved to maintain their connection and dependance with the regency and Cortes at Cadiz. Armies were formed, and marched to attack those who were unwilling to enter into a revolution. The measures of the Junta of Caraccas being taken with more violence than judgment, all failed, and their armies were defeated and dispersed. Whilst the turbulent spirits of the city of Caraccas were thus plunging the province into all the miseries of a civil war, they took great pains to excite similar movements in New Granada. The inhabitants of that country were less disposed to insurrection; and it was not till three months after the revolution in Caraccas, that any similar movement took place in Santa Fé de Bogota, the capital of New Granada. In July, a public meeting appointed a Junta of its most respectable Creole inhabitants. This body, when they met, acknowledged the authority of the regency of Cadiz, chose the Viceroy as the president of their body, and confirmed the authority of the Audience, and the other magistrates. After a short time, however, the turbulent people, instigated by the emissaries from Caraccas, caused a commotion. The pretence for this was, that a plot was discovered for the destruction of liberty. The populace overawed the newly-installed Junta, who, with little inquiry, and no trials, decreed the banishment of the Viceroy, the Audience, and the other magistrates. The authority of the regency of Cadiz was then disavowed, and the various provinces of the viceroyalty were invited to send deputies to the capital, to unite in a general system. Tunja, Pamplona, Casanare, Choco, Antioquia, Socorro Neyva, and Mariquita, joined in the project, and sent their deputies, whilst Santa Marta positively refused. Popayan, torn by internal factions, yielded a qualified consent; and several towns, es-

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pecially San Gil, Carthagena, Giron, and Mompox, formed petty states in their respective districts, independent alike of Spain and of the junta of the capital. An insurrection had broken out in Quito. Some troops from Lima had suppressed it; but, as the inhabitants were averse to the superiority of Lima, the viceroy acquiesced in the establishment of a junta, which acknowledged obedience to the regency of Cadiz, and preserved the tranquillity of that important portion of the country, whilst the more northern parts were suffering all the horrors which a revolution can inflict, when a rude and ferocious populace are the principal actors. Quito was not doomed, like Caraccas and Santa Fé, to have all its magistrates transported by the decision of the populace; and, therefore, a degree of order has been continued, which now gives it a prosperity, far superior to that of the districts which were at once deprived of all the authorities to which they had been accustomed to look up.

Commencement of the Civil War.

A civil war commenced to subdue those places which aimed at independence, or, according to their own language, resolved on a government of federative republics. After much savage warfare, these federalists were subdued, and a congress was assembled. Disputes arose among the members about their nomination, and, with a few impracticable decrees, they soon separated, without allaying the ferment, or suspending the general hostilities, that covered the face of the country.

The separation of the first congress took place within six months of the commencement of the insurrection, in December 1810, or January 1811, and left the whole country suffering under internal hostilities of the most ferocious description.

During the year 1811, Tacon, the Spanish governor of Popayan, maintained a feeble resistance; but at length he liberated and organized the negro slaves, and, at the head of these black royalists, annoyed the republicans on the side of Pastos, whilst the people of Maracaybo, and of Santa Marta, continued their opposition in two other quarters. This opposition of the royalists occasioned, however, but trifling evils, when compared with the sufferings which the different parties of the republicans inflicted on each other.

Another congress was assembled, consisting of the representatives of Pamplona, Tunja, Neyva, Carthagena, and Antioquia, whilst an assembly, under the title of *Colegio Electoral Constituyente*, sat, deputed by the province of Santa Fé, now called by them Cundinamarca. Each of these bodies formed projects of constitutions, but neither would accept that framed by the other. It would be tiresome to give even the briefest abstract of the projects and the arguments of the parties, which are, however, recorded in most voluminous state papers. The congress of Cundinamarca, from fear of the populace of its capital, removed its sittings to Tunja. Whilst there, they chose for their president one Narino, who had been a spectator of the French Revolution, and who had returned to his native province full of the projects and language to which it gave birth. Having the command of the troops, he proceeded to disperse the congress; but the division dispatched for that purpose refused to act, and, suddenly changing sides, declared for the congress. Narino had still a considerable force which was attached to him; more than equal, indeed, to the part that had deserted him. The congress vested the command of the army, which opposed Narino, in Baraya, the officer employed to dissolve them, and who was accused of having been withdrawn from his obedience to Narino by a considerable bribe.

A civil war now spread over the country. Narino was twice defeated; and, in consequence of it, the army under Baraya was enabled to besiege Santa Fé, the capital, which was possessed by the partizans of Narino. That chief proposed to surrender upon terms which the besiegers refused. It was attempted to be stormed; but the besiegers were repulsed with such loss, that their army was dispersed, only a small division making good its retreat to Tunja.

Whilst these events were passing in the centre of the viceroyalty, the southern part became equally agitated. The city of Quito had a junta, and, as we have before stated, acknowledged the authority of the regency of Cadiz. From the turbulent state of the populace, it could, however, scarcely keep the full exercise of authority. The royalist province of Cuenca, which adjoined it, had organized a military force. The regency at Cadiz had nominated a new governor of Quito, who was escorted to his government by a body of troops from Lima. The junta of Quito, though willing to receive a governor from Cadiz, would not permit him to enter with the royal troops, and formed an army to oppose him. The troops from Cuenca, and those from Lima, after some opposition, took Quito, and installed the new governor. He immediately commenced operations against the republicans. Upon this, the congress and Narino suddenly adjusted their disputes, and he was placed in the command of the united army to oppose the royalists from the south. Narino, at the head of 8000 men, engaged the royal army, commanded by Samano, and defeated it; but it rallied, was reinforced, and fought two other battles with similar success. By these events Narino became master of Popayan, and began to organize something like a government. The royalists were dispersed, rather than destroyed, and, retiring to the impregnable mountains of Pastos, maintained an incursive and predatory warfare. Narino followed them to their fortresses, and carried the strong position, called Alto de Juanamba, but with prodigious loss. He advanced to attack the town of Pastos; but a report, in the moment of commencing the assault, that he was taken prisoner, having spread among his troops, it produced confusion. The royalists suddenly became the assailants, and dispersed the irregular troops he commanded. He was made a prisoner, and with him the hopes of success to the southward of Popayan terminated. His life was spared; he was conducted to Quito, thence to Lima, and has since been transferred to Spain, where he is said to be chained for life in one of the dungeons in the vicinity of Cadiz. The event that terminated his career happened in June 1814.

We have already stated that Carthagena had, when the disturbances first began, declined joining the party that had predominated in the capital. The

province of Carthagena contains a population of 220,000 souls, of whom about 24,000 reside in the city of that name. In August 1810 a junta was convoked, consisting, as in most other places, principally of members of the Cabildo. The authority of the regency of Cadiz was acknowledged in their decrees, but they refused to receive a governor appointed by that body, and thus became embarked in the revolution. Early in 1811, like the other communities, they began to arm the population. The junta, in February of that year, was debating on some regulations of the armed force, when the troops revolted, and dissolved the assembly. A new assembly was more indulgent to the soldiery; and, because the town of Mompor did not acquiesce in their measures, and wished to be represented in the congress previous to their obeying it, it was attacked, taken, and the principal inhabitants imprisoned or banished. In November 1811 an insurrection compelled the congress to declare all connection between the province and Spain to be terminated, and demanded a republican constitution. War was carried on with Santa Marta on one side; a state neither of peace nor of war existed with Santa Fé, and the government of Spain, in denouncing them as rebels, had interdicted all their commerce. The sufferings of the province were great, and their apprehensions increased, first, by the disputes between Narino and the congress of Santa Fé, and afterwards, by the defeats which were experienced when those opponents united against the royalists. By a convulsive effort they conquered Santa Marta; but the atrocities practised by their troops excited the inhabitants to rise upon them, and drive them out; and receiving reinforcements from Portobello, Havana, and Maracaybo, they were enabled to repel several subsequent attacks The whole of the year 1813 was occupied by these successive events, during which a constitution had been formed, which, however, was never so far put in execution as to protect the inhabitants from the tyranny of the mob of the capital. The government, having no revenue, and confiscations having ceased to be productive, issued paper money, which soon became of no value, and with no authority to enforce obedience, remained for two years in a state of stubborn helplessness, till they were roused from their lethargy by an attack made on them from Santa Fé, whose army had crossed the province and invested the city, when a formidable force from Spain, in 1815, appeared on the coast.

We must now return to the province of Caraccas, whose revolutionary progress was proceeding with great rapidity. As soon as every vestige of dependance upon Spain was destroyed, attempts were made to reduce the neighbouring provinces to the authority of their congress. A fresh attack upon the city and district of Coro was made by an army of 3000 men, but it failed in its objects, and returned in a state of great disorganization. General Miranda made his appearance on the stage of his native country, from which he had been absent more than thirty years. On his arrival, by the assistance of Espejo, he established a club under the title of *Sociedad Patriotica*, which first directed, and then overturned, the junta. It assumed extravagant authority, issued its decisions in the most peremptory tone, instituted nocturnal searches, secret trials, and summary executions. Under pretences of plots against liberty, the richest inhabitants were either put to death or banished, and their effects confiscated to the public. The city of Valencia had refused obedience to the decrees of the capital. Miranda was dispatched with a force to subdue it. The first effort failed, but being reinforced, he at length captured that city, and with four thousand men made an unsuccessful attempt upon Coro. The year 1811 was occupied by these operations, and by the attempt to form a constitution. They had possession of the whole country except Coro with its district, and the fortress of Porto Cavallo on the sea coast. No enemy had attacked, or were prepared to attack them; their own internal dissentions were, however, more disastrous than the most ferocious foreign foe. The revenue was destroyed, confiscations could be no longer practised, the paper money they had issued was no longer of any value, a maximum that had been laid on provisions had produced scarcity, and no authority was obeyed but that called the voice of the people. A negotiation had been opened with New Granada, with the project of uniting, under one federal government, those two provinces, which were each so disunited internally, that neither could depend on its inhabitants complying with any stipulations that might be mutually settled between them. The clergy had first joined the insurrection. As long as the object was to prevent the provinces from becoming subject to France, and by that subjection to risk the loss of their religion, and the emoluments by which it was supported, the body of the priests, both secular and regular, favoured the cause of the junta. In a short period the wealth of the church was deemed a fair auxiliary to the wants of the state, and toleration to other faiths than the Catholic was projected. The clergy became alarmed at the innovations, and with a bigotry, which was assisted by the practice of auricular confession, instilled into the population unfavourable views of the designs of the ruling party.

In this state of affairs, on the 26th March 1812, the aniversary of the day on which the revolution had commenced, the province was visited with a tremendous earthquake. In its progress many cities were destroyed, and the loss of human lives, especially of the public functionaries and the military, was augmented from its occurring on a religious festival, when the greater part of them were in the churches employed in the celebration of the rites appropriate to the day. The depots of arms and of ammunition, as well as the barracks, were thrown down, and the instruments of war buried in the ruins. The priests represented this calamity as a demonstration, that the Deity was opposed to the revolution; and they were favoured in their interpretation of the event, by the circumstance of the greatest suffering being experienced in those places which had been most fervent in the revolt; whilst Coro, Valencia, and other places which had opposed it, had either wholly escaped, or been slightly injured by the visitation. The Spanish General Monteverde had been sent from Cadiz with a commission, but without troops; he, however, collected a handful of men; terror disarmed the few troops under Miranda, who refused

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to fight, and the royalists, joined by the independents, who eagerly flocked to support the cause which was represented as favoured by Heaven, soon obtained possession of the whole country, which, by August 1812, was reduced to submission. The cruelties exercised by the royalists, under the plea of retaliation, were excessive; and the versatile populace of the large towns, after a year of quiet endurance, discovered dispositions to renew the revolt. The first ebullition of popular fury was displayed at Cumana, the second city in Venezuela. An insurrection burst forth, which drew towards it Monteverde with his troops. He was unsuccessful, and retired to bring up reinforcements. He made a second attempt, but with a worse result. He was not only repulsed, but subsequently defeated, and thus, in the begining of 1813, the royalists were expelled from the eastern division of the country.

Operations of Bolivar.

Whilst this operation was proceeding in the province of Cumana, a most formidable enemy to Spain made his appearance on the theatre of war. Don Simon Bolivar, a native of Caraccas, was deputed, at the commencement of the revolution, to apply to the British government for assistance; he returned from his mission whilst Miranda ruled in Venezuela, and, from disgust at that officer, had been a spectator rather than an actor in the commotions of his country. After the earthquake, he was appointed commandant of Puerto Cavallo, and upon the surrender of that fortress to the royalists, he apparently submitted to Monteverde. He repaired to Curaçoa, where he formed a connection with Brion, a native of that island, which has since led to an important alliance, and procured him maritime cooperation. Bolivar passed to Carthagena, and was employed by the republicans of that city in their operations against Santa Marta and the other royalist provinces. Whilst the Congress of New Granada was sitting at Tunja, Bolivar applied to them for some troops to assist in rescuing Venezuela from the hands of the Spaniards. They committed six hundred men to his command, and with them he began his operations from the westward, at the time the revolt broke out at Cumana. The conduct of both parties had been sanguinary beyond the ordinary limits of modern warfare; but, from this period, it exhibited a ferocity unexampled in recent periods. No quarter was given on either side in battle, and the prisoners taken in small parties or in towns were uniformly put to death. Bolivar advanced with his battalion from Tunja, and having surprised a detachment of the royalists at Cucuta, was joined by large parties of migratory horsemen from the province of Barinas. He made a rapid progress; the Spaniards either flying before him, or being defeated when their inferior number presented any resistance. At length a considerable body of horse, who had been engaged by Monteverde in the royalist cause, suddenly abandoned him and joined the invaders. Bolivar continued to press on, every place in his progress favouring his enterprise till he reached the capital. When near the city of Caraccas, the Spanish officer who commanded there, offered to evacuate, if suffered quietly to repair to La Guyra, which port was held by the royalists.

Thus the whole of Venezuela was again in the hands of the patriots at the end of August 1813, except the two ports of La Guyra and Puerto Cavallo, the latter of which was besieged, but resisted, and formed a rallying point, from whence Monteverde made furious and most successful sallies, till the besieging army was compelled to retreat. For some time after this siege was raised the warlike operations languished, and a political farce was acted by Bolivar. When the Congress of New Granada placed some troops under the command of that chief, it was with a positive injunction to place the power he might acquire in the hands of the Republican Assembly of Caraccas. He called an assembly all nominated by himself; and when convoked, in January 1814, one of his partisans addressed the members, stating the necessity of placing the supreme power in the hands of Bolivar as long as hostilities with Spain should continue. None durst, or at least none did object to this proposal. He was declared sole Dictator of Venezuela, until the union could be effected with New Granada, when both were to be joined in one republican government, and his authority was then to cease, and, in the mean time, he was to bear the title of *Libertador de Venezuela*. He was scarcely installed in the dictatorship, when a more formidable attack than had before been made drove him from his government. Some royalist natives arranged the plan, and executed it with but feeble if any assistance from the European government. Boves, Rosette, and Yanez, three men of colour, gathered some recruits as they advanced from the side of the Orinoco, by proclaiming freedom to those slaves who would join the royal standard. Puy and Palomo, of the mixed castes, also adopted the same plan on the side of Barinas. These chiefs, as they advanced towards the centre of the country from opposite points, increased in numbers, and carried devastation wherever they came. The republicans were unable to resist them. As the royalist banditti gained the district called *Los Llanos* or the plains, which is covered with innumerable horses, they were enabled to mount their men, and prevent Bolivar from obtaining horses for his cavalry.

By an opportune movement of the republicans in Cumana, and a victory over Cagigal, the Spanish general who had succeeded Monteverde, Bolivar became somewhat less embarrassed, and attempted some offensive operations. With little judgment, he divided his army into three bodies, destined for different attacks on the royalists. The division he commanded in person engaged with Boves, and, after a most sanguinary conflict near Cura, was completely routed. The second division, commanded by Narino, was opposed to the regular troops under Cagigal, and compelled to retire to Cumana. The third division, under Urdaneta, when apprised of the ill success of the other two, retired towards Santa Fé with the few men that had not deserted during his retreat. Bolivar, after his defeat and the dispersion of his troops, made his escape to Carthagena, and from thence proceeded to Tunja, where the Congress of New Granada held their sessions. After his departure all Venezuela became the prey of the conquerors, and those made prisoners were executed with the same unrelenting severity as Bolivar had practised on those that fell into his power.

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When Bolivar reached Tunja, the congress was engaged in hostilities with its own refractory capital, the city of Santa Fé de Bogota. The command of an army was offered to him; he marched at its head, and succeeded in reducing the citizens to submission. He was then commissioned to join with the republicans of Carthagena, and reduce to the authority of the congress the royalist province of Santa Marta. The president of Carthagena refused, as he declared, on account of the sanguinary conduct of Bolivar, and his ambitious views, to co-operate with him, and thus hostilities were again kindled between the two provinces. Bolivar entered the province of Carthagena, and advanced to besiege the capital, hoping to reduce it, and compel it to submit to the congress. At this period, intelligence arrived that the forces from Spain had reached the shores of America. Bolivar quickly accommodated his disputes with the republicans in Carthagena, entered with his forces into the city, and resolved to contribute with them to its defence.

Atrocious Character of this Civil War.

We have now brought down the transactions of these different communities to the same period,—the time when the forces from Spain first reached these shores in the middle of the year 1815. Before the narrative proceeds, it may not be improper to remark, that the scenes of confusion, the exhibitions of cruelty, and waste of human life, which we have avoided drawing in their deepest colours, arose solely from internal causes. Not a battalion from Spain had arrived. No external hostilities were even threatened; the vengeful feelings of rude and uncultivated men were stimulated by representations of the happiness to be derived from the various systems of government which different parties patronized, and they were alone sufficient to produce all the atrocities that were exhibited. The reader would sicken at the recital of the bloody documents from which this narrative has been framed; but as some specimen ought to be shown of the temper of the contending parties, we relate two transactions, which are too well authenticated to admit of a doubt, and the actors in which were not Spaniards but Americans, prompted by direful hatred, or political fury. Puy, a royalist chief, was at Barinas, where had been brought five hundred and seventy-four persons of the opposite party, who were to be detained for examination. A report reached Barinas that the republicans, with superior numbers, were at hand, the execution of these prisoners began, and five hundred had been dispatched, when one of Puy's aid-de-camps reported that the enemy would be instantly upon them. "Have we not time," demanded the chief, "to execute the remaining seventy-four prisoners?" "No," replied the officer, the retreat began, and thus these were saved. The apologist for Bolivar, in a narrative drawn up to exculpate him, says, "The massacre of three of the inhabitants of Ocumare in the church, created indignation in the mind of Bolivar, who, thirsting with revenge, though overpowered with care, did not know on which side to turn his attention. In one of those agonizing moments, in which his soul was first swayed by fear, then worked up to anger, he gave orders for the execution of the prisoners, and, shocking to relate, eight hundred were killed on this occasion." When the royalist commandant at Puerto Cavallo heard of these executions, he put to death all his prisoners, amounting to several hundreds.

Arrival of Forces from Spain.

When Ferdinand was restored to his throne, the knowledge of that event produced a calm throughout the American dominions. It was, however, but of short duration; those who held the power were unwilling to relinquish it at the call of the people, in whose name they pretended to rule. It was necessary to temporise, and they stated that deputies should be sent to Madrid to secure a general amnesty, and to reconcile them to their liberated monarch. At the same time, other deputies were sent to England, with offers of exclusive commerce for a term of years, upon condition of supporting their resistance; and others were sent to the United States of America and to France with similar proposals. Spain was in too exhausted a state to send numerous armies, even if she had not been induced to suspend her armaments, from the assurances of fidelity and submission which the deputies were instructed to make. At length, however, a force under Morillo sailed and arrived, whilst hostilities were raging, with the greatest fury, between the different parties of Americans. The first important operation was the siege of Carthagena, within which Bolivar and his forces were inclosed. That chief escaped with a portion of his troops, and abandoned the city to its fate. A protracted siege, with far more than its usual share of horrors, was at length followed by the surrender. The Spaniards entered it on the 6th December 1815.

Morillo, after the capture of Carthagena, made preparations to scatter the congress, occupy the capital, and tranquillize the country. Mompox, an important town on the river Magdalena, had been taken by the royalists from Santa Marta; this facilitated the operations of the Spanish general, who, with little loss, reached that place in March 1816. The congress of New Granada collected all their forces to oppose the regular troops, who, elated with success in their first operation, defeated a more numerous army, which fought with desperation at Cachiri. After this defeat, it rallied and fought another battle, with rather more success, at Remedios, but it was unable to withstand regular troops, and at length dispersed, when Morillo finished the war by the capture of Santa Fé de Bogota, which he entered in June 1816. The congress had dispersed, some of the members were taken, several of them executed, with but little formality of trial, and some escaped to the English islands and the United States of America. Though the Spaniards caused several executions of the leading political men in Santa Fé, there was none of that indiscriminate slaughter and general pillage which the city had experienced when captured before by Bolivar. Tranquillity had been restored so far, that neither juntas nor armies existed; but bands of robbers ravaged the country, too powerful to be kept in awe by the regular magistracy, though too weak to make opposition to the regular forces. Morillo, on his way to Carthagena, had captured the Island of Margarita, which is a strong post, and enjoys the benefit of an excellent harbour, easy to be defended. After he left that place, the inhabitants, under Arismendi, threw

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off the yoke of Spain, asserted their independence, and strengthened the fortifications. Bolivar had saved the wreck of his army, and after recruiting them at Aux Cayes, in the Island of St Domingo, repaired with his forces to the asylum which Arismendi had provided, and was there soon joined by Brion with some vessels that he had procured.

After making some demonstrations on the coast of Caraccas and New Granada, without producing any impression, these two officers, with a land and sea force, at length sailed for Guyana, and entered the river Orinoco; and another chief having taken Old Guyana, a fortress which commands a narrow part of the river below the capital Angostura, they were enabled to besiege and capture that place. From the superior force of small craft on the river, and from the possession of Old Guyana, their position there was perfectly secure from all attempts of the Spanish forces. In this place, Bolivar began to increase and organize his forces, whilst his colleague Brion made many successful cruizes, and captured some valuable Spanish vessels.

The population of the country is too thin to afford many recruits, though some joined the insurgent standard from the southern part of the province of Caraccas. Their principal support was there derived from those numerous military men who had been deprived of occupation by the peace in England, France, and Germany. Agents from the South Americans were fixed in many parts, who gave great promises of encouragement to such as would volunteer their services. Many were induced to repair to the standard of Bolivar, by which, in the beginning of 1817, he was enabled to commence his operations, by ascending the river Apure, designing to attack the capital of Caraccas from the plains or Llanos that bound it on the south. In three or four months he had advanced towards Calobozo, when the army of Morillo were on the opposite side of the country. He was so far successful as to secure that place, but before he could reach the defiles which lead to the Caraccas, they were occupied by Spanish regular troops, which prevented his progress.

The greater part of the year was occupied both by the Spaniards and the Americans in strengthening the two opposing armies. The campaign of 1818 was opened by Bolivar, who again attempted to force the passes that communicated with Caraccas, but the Spanish army was so much increased at that point, that they not only resisted, but, after a weak attempt on his part, which was repulsed, became the assailants. Several battles were fought, in which, if they were not decisive, the Spaniards seemed to have the advantage; at length a battle near Ortin determined the fate of the campaign, and compelled Bolivar to abandon Calobozo, and descend the river to his former asylum at Angostura. There he was joined by various parties of Europeans, who were at length organized and prepared for the grand expedition. Though the party that rallied round Bolivar were designated the Venezuelan Republic, yet for two years they had not been able to gain one foot of territory in that country, unless the Island of Margarita could be called a part of it. As the attack on that country seemed hopeless, he directed his attention to the province of New Granada. His river craft was much superior to any that the Spaniards could bring to oppose it. He had been strengthened by numerous recruits from Europe, who, however mutinous and predatory, were endowed with high spirit and much courage, and they constituted the most important part of his forces. The navigation from the Orinoco and up the river Meta is a tremendous operation, but it was attempted and succeeded. The forces that Bolivar had collected at Angostura were embarked in various small craft; after ascending the river to the junction of the Meta, and mounting that stream, they had scarcely any opposition to apprehend from armed force, for the Spaniards were waiting their approach on the Llanos that separate Guyana from Caraccas. The few troops near Santa Fé de Bogota were insufficient to impede the progress of the insurgents even at the passes through that ridge of mountains in which the Meta has its source. The capital of New Granada fell into the power of the invading force, but no accounts have reached Europe of the particulars of that event, which occurred in August 1819, nor of any subsequent transactions.

Whilst Bolivar was carrying on his operations in the interior, expeditions against several points on the coast were conducted by persons from Europe, who professed to act under the authority of the Venezuelan Republic, or the Republic of New Granada.

Macgregor, who had been a Lieutenant in the British army, and had served in 1815 under Bolivar, collected a force with which he surprised Portobello, but was in his turn surprised, and, though he himself escaped with part of his forces, a large part of them were sacrificed. He afterwards, when recruited by fresh arrivals from Europe, made an unsuccessful attempt upon Rio de la Hacha. The repulse produced commotions among his forces, and they are now nearly dispersed.

Another expedition, fitted out in Europe, under an Englishman of the name of English, under Venezuelan colours, was directed against Cumana. It captured the open town of Barcelona on the coast, and proceeded to that city, but the attempt was repelled with considerable loss on the part of the assailants.

One thing seems certain, that the inhabitants of the country take no interest in the contest, nor have done so, since the commencement of the year 1816. Since that period, the insurgents have almost wholly relied on the efforts of the numerous Europeans that have joined their standard. Whether this quiescent state of the natives has arisen from disgust to the cause or indifference to it, from the fear of the vengeance of the Spanish troops, or from the total deficiency of all weapons but those furnished from Europe, it is as difficult to determine as it is to foresee what will be the final issue of the contest.

(W. W.)

GREAT BRITAIN.*

War with France and her Allies.

UNDER the word BRITAIN, in the *Encyclopædia*, the history of our affairs, as well as of the more interesting events on the Continent, is brought down to the renewal of hostilities with France, in 1803. We now resume our narrative from that period, dividing it under the following heads:

War with France and her allies, until the general pacification of 1814.

War with the United States, from 1812 to the beginning of 1815.

Return and second overthrow of Bonaparte.

Parliamentary and domestic history from 1803 to 1820; followed by a short notice of the affairs of Ireland.

I.—*War with France and her Allies from* 1803 *to* 1814.

Hanover.

On the Continent of Europe, the only great operation was the invasion, or rather occupancy, of Hanover. War was declared by us on the 18th May, and the French troops had advanced from Holland, and entered the electoral capital by the 5th June. To attempt resistance would have been folly; but in a season when soldiers were so much wanted in England, and so great an expence was incurred in training them, it was matter of regret that the Hanoverian troops, in number about 15,000, should not have been marched down to the coast, and embarked in a body, instead of being disbanded and obliged to pledge themselves not to serve against France until exchanged.

Boulogne Armament.

On the side of France the aspect of war was displayed in a great encampment at Boulogne, and in the dispatch, from all the ports along the coast, of flotillas of boats to join the armament preparing in that central rendezvous. These petty convoys seemed to have instructions to tempt our cruisers to attack them, and to draw them, at fit occasions, under the fire of land-batteries. The main object of Bonaparte was to excite alarm; a course, which, however politic toward some countries, was certainly ill judged in regard to one where the executive power, in its inability to coerce, often seeks support in the apprehensions of the public. The general impression of dread facilitated the measures of defence, and led to an unparalleled extent of the *Volunteer System*. Never did a country exhibit so many of the middle and higher classes under arms as England and Scotland in 1803; and never did individuals, in these stations, make more personal sacrifices for the object of national defence. The result was effectual to as great a degree as the situation of the individuals permitted. The volunteers made as near an approach to regularity of discipline as was practicable in the case of men full of ardour, and submitting for a season to the restraint of military service, but necessarily devoid of experience in the field. The error lay in carrying volunteering too far; for the system ought never to have been allowed to extend to a length that absorbed no inconsiderable part of the time and money of men whose lives were too valuable to be indiscriminately exposed, and whose proper aid to the public cause was the tribute of their industry. The volunteer system was of real use only in as far as it promoted cordiality in the common cause, and by assuring the maintenance of tranquillity at home, enabled government to dispose of the regulars in the field.

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The plan of collecting flotillas of boats, from East to West, in the central depôt of Boulogne, was continued by Bonaparte, during two years, from the middle of 1803 to that of 1805. A great parade was made of the number of troops ready to embark, and of the determination to encounter all hazards; but there was no efficient support by ships of war, until, in the spring of 1805, the sailing of squadrons for the West Indies took place, first from Rochefort, and afterwards from Cadiz. These, it was calculated, might excite alarm for our colonies, and induce government to send thither a part of the men of war hitherto reserved for home defence; after which the hazardous attempt of a descent might have entered seriously into the calculations of the French ruler. That it did so at this time was positively affirmed by him in conversations held in 1814 with English gentlemen in the Island of Elba; but these conversations, to minutes of which we have had access, were marked by Bonaparte's usual misrepresentations, for he attributed the non-execution of the attempt entirely to the threatened coalition on the Continent, and would not acknowledge that it was impracticable, —a matter of nautical calculation, when our Government kept our Channel fleet at home, instead of sending it, as he had anticipated, to the West Indies.

Naval Operations.

Such was the aspect of the war during two years, in which our naval superiority led to an easy conquest of several of the Dutch and French West India colonies. St Lucie surrendered on 22d June 1803; Tobago, on 1st July; Demerara and Berbice, on 23d September; Cape Town, the last spot in the French half of St Domingo, occupied by French troops, was made to capitulate to the Blacks, on 30th November. Next year was taken the small Island of Gorée on the coast of Africa, and soon after the important Dutch colony of Surinam. On the other hand, we were not successful in our attempts on the French flotillas on their own shores. One of these was directed against a convoy on the coast between

March 9, 1804.

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* See the references from the word BRITAIN, Vol. II. p. 523, and from the article ENGLAND, p. 108 of this volume.

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Flushing and Ostend; another, on a larger scale, and very different plan, was pointed at the Boulogne armament, which it was proposed to blow up by *catamarans*, an attempt no less unsuited to open and generous warfare than the torpedoes of the Americans. Fortune was more favourable to us in encounters with the enemy in the open Ocean, where, in the early part of 1804, a striking proof of the effects of intrepidity was given in the case of a fleet of merchantmen from China, which beat off, or at least deterred from action, a French squadron under Admiral Linois, consisting of a ship of 80 guns and three frigates.

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The war hitherto had been with France and Holland only; but a new power was now to be added to the list of our antagonists. Spain had been allowed by Bonaparte to avoid participating in the contest, on condition of paying a large annual contribution; a condition, so contrary, as was alleged, to real neutrality, that, for some time past, our Government had kept a vigilant eye on the expected arrival of her treasure ships from America. A small squadron of four frigates, sent out to intercept these valuable supplies, met, on 5th October 1804, a Spanish squadron of a similar number proceeding towards Cadiz. The Spanish commodore refusing to surrender, an engagement ensued, attended with the capture of three of the Spanish frigates, and the explosion of the fourth with the loss of many lives. This decisive act, approved at home by the advocates of vigorous measures, was productive of the worst impressions in regard to our national honour both in Spain and her colonies, and led, soon after, to a declaration of war. Bonaparte was now provided with additional means of threatening our distant possessions. A squadron of five sail of the line escaping from Rochefort, landed a body of nearly 4000 men on the Island of Dominica, and burned the chief town; the Island of St Kitt's escaped with paying a contribution and the loss of some merchantmen. But this was only a prelude to the arrival of a much more formidable fleet, which, to the number of eighteen sail of the line, French and Spanish, reached the West Indies in the end of May, and spread alarm throughout the Islands,—an alarm not dispelled till the arrival of a force inferior by one-third, but commanded by Lord Nelson. The hostile fleet soon after set out on its homeward voyage. Intelligence to that effect was opportunely received by Lord Barham, then at the head of the Admiralty, and a fleet, detached to cruise on their supposed track, had the good fortune to fall in with them on 22d July. An action took place; two sail of the line (Spanish) were captured; night closed the conflict, and though it might have been renewed on the succeeding days, an unfortunate indecision on the part of our admiral, Sir Robert Calder, allowed the enemy to escape. They repaired to Ferrol, whence they soon after sailed with augmented force, and reached Cadiz. To watch them there, or to engage them on their coming out, was an object of the highest moment, and it was to Lord Nelson that the important trust was committed. Joining our fleet off Cadiz, he avoided keeping in sight, and even dispensed with the aid of six sail of the line, which he sent to a distance along the coast; judging that the enemy, when apprised of their absence, would be induced to come out. Accordingly, the combined fleet left Cadiz on the 19th October to the number of 33 sail of the line (18 French and 15 Spanish), commanded by Admiral Villeneuve, and early on the 21st came in sight of the British fleet consisting of 27 sail of the line. The scene of conflict was off Cape Trafalgar, nearly half way between Cadiz and Gibraltar. The enemy, convinced that their former defeats at sea had been owing to the want of concentration and mutual support, now formed a double line, so that any of our ships, attempting to penetrate, should be exposed to the fire of two or of three antagonists. Nelson, while yet distant, perceived their arrangement, and understood its object. It was new, but he was satisfied that no concentration in the open sea could prevent our vessels from coming to close action with their opponents, in which case the result could not long be doubtful. He made, consequently, no alteration in his previous plan, but directed his fleet to advance to the attack in two divisions, one of which, under Admiral Collingwood, intersected that part of the enemy's line, which gave it a nearly equal number of ships to encounter, while Nelson with the other division, acted on a similar plan Such was the only general manœuvre in this great action; by our superior seamanship, and our ships keeping near each other, we had, in some cases, a local superiority, but the general character of the fight was a conflict of ship to ship, and its decision, in our favour, was owing to that skill in working the guns, to that dexterity in an occasional change of position, and that confidence of success which characterizes a naval force in high discipline—advantages which we had displayed with such success against the Dutch at Camperdown, and the French at Aboukir, and in which we met with no equal opponents till we encountered the Americans. Our loss, amounting to 1600 men, was in part caused by the riflemen in the enemy's rigging,—an ungenerous mode of warfare, which may deprive an opposing force of officers, but can have little effect on the general issue of a conflict. The fighting began at noon, became general in less than half an hour, and lasted from two to three hours; in the case of a few ships it was longer, but all firing was over by half past four o'clock. Nineteen sail of the line struck; but unfortunately gales of wind, after the action, wrecked part of our prizes, and necessitated the destruction of others; four sail, however, were preserved, and four more, which had escaped, were met on their northward course, on 2d November, and captured off Cape Ortegal by a squadron under Sir Richard Strachan.

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War with France and her Allies.

Battle of Trafalgar.

Continental Affairs in 1805.

But on the Continent of Europe the course of public events was very different. The year had been ushered in by a letter of Bonaparte to our Sovereign, containing pacific professions expressed in general terms. An answer was given, not by the King, but, according to diplomatic usage, by our Minister for Foreign Affairs to the French Minister in the same station; expressing a similar wish for peace; but adding, that it was incumbent on us to consult our allies, particularly the Emperor of Russia. The French ridiculed the assertion of our being on

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confidential terms with that court; but Russia had, in fact, begun to listen to the proposal of forming against France a coalition on an extensive scale. The basis of this compact was a treaty signed at St Petersburg in April. Russia, Austria, Sweden, Naples, all acceded to it, and hopes were entertained of the co-operation of Prussia. Bonaparte, apprized of this, affected to be absorbed in arrangements for immediately invading England, but secretly prepared to march his troops from Boulogne to the Rhine. After throwing on the Austrians the odium of aggression, by allowing them to attack Bavaria before he acted, he proceeded to execute a plan singularly adapted to the overweening confidence of his opponent, General Mack, who, by this time, had traversed Bavaria, and advanced to Ulm. By making forced marches, and by violating part of the neutral territory of Prussia, Bonaparte reached first the flank, and soon after the rear of the enemy, who clung, with blind pertinacity, to the position of Ulm. The result to the Austrians was a series of
Oct. 17. checks in the field, and, eventually, the surrender, by capitulation, of more than 30,000 men. The road to Vienna was thus opened to Bonaparte. He marched thither, crossed the Danube, proceeded northward, and at Austerlitz, on 2d December, displayed his military combinations in all their lustre, gaining, with forces not superior, a victory, which compelled Austria to immediate peace; and thus, by one blow, broke up the coalition.

Naval Actions in 1806.

Such was the alternation of fortune by sea and land, that the next year had hardly commenced, when fresh successes were obtained over the French navy. A division of the Brest squadron, after landing troops in the Spanish part of St Domingo, were overtaken by a superior force, and three sail of the line captured, and two burned. Admiral Linois, re-
March 13. turning from India, was captured in the Marengo of
Sept. 25. 80 guns; and, at a subsequent date, of a squadron of frigates detached from Rochefort for the West Indies, four fell into our hands.

Negotiation at Paris.

It was under these circumstances, that a negotiation for peace was for some months carried on at Paris. It began in consequence of an overture from Talleyrand, eagerly embraced by Mr Fox; and Lord Yarmouth, who happened to be under detention in France, was made the first medium of communication and conference. In its more advanced stage, the negotiation was entrusted to Lord Lauderdale; and, at one period (in September), the conciliatory tone of the French inspired a hope of peace;—a hope soon disappointed, when it was found that the offers of Bonaparte were followed by the demand of Sicily; and that, while professing an ardent wish for peace, he was extending his usurpations in Germany, and secretly preparing to subvert the power of Prussia.

Prussia.

The humiliation of Austria left Bonaparte at liberty to direct his manœuvres, both diplomatic and military, against her northern rival. Affecting great indignation at the friendly disposition shown by Prussia the preceding autumn towards the coalition, he demanded the cession of a portion of her territory in the south-west, and, in return, transferred to her Hanover, in the hope of kindling the flame of discord between her and England. The Prussians accordingly entered Hanover; the local government making no resistance, and our Cabinet taking no retaliatory measure, except the detention of vessels bearing the Prussian flag; a measure adopted not in the spirit of hostility, but to satisfy popular clamour in England. The discussions between France and Prussia continued during the summer of 1806, and, from the blind confidence of one party, and the art of the other, assumed at last a serious aspect. The battle of Jena (see the article FRANCE, towards the close) deprived Prussia of her army, her capital, her fortresses; and her court was fugitive in the north of Poland, ere there had been time to send, or even to concert the sending of succours from England. The Grenville ministry, less eager than their predecessors to embark in Continental war, confined themselves to sending a general officer (Lord Hutchinson) to the Russian head-quarters, and to the grant of a limited subsidy. For some time, the difficulties of the country, and the firm resistance of the Russians, particularly at Eylau, encouraged the hope of arresting the progress of Bonaparte; but this hope was disappointed by the battle of Friedland, and still more by June 14,
the approximation of the court of Russia to that of 1807.
France.

The treaty of Tilsit excited alarm, less from its July 1.
specific provisions, than from the probable consequences of the co-operation of the contracting powers. Among these, some persons reckoned, or pretended to reckon, the equipping against us of the Danish navy, a force of sixteen sail of the line, not manned or ready for sea, but capable of being fitted out without a great sacrifice. The ministry of 1807 founded their claim to public favour on a system of vigour, on a course altogether opposite to the cautious calculations of their predecessors. No sooner were they apprized of the treaty of Tilsit, than, without waiting for its effect on the Danish government, they determined on the as yet unexampled measure, of taking forcible possession of a neutral fleet. A powerful armament of 20,000 troops, and twenty-seven sail of the line, prepared ostensibly against Flushing and Antwerp, was directed to proceed to the Sound, there to await the result of a negotiation at Copenhagen. This negotiation was entrusted to a special envoy, who represented the danger to Denmark from France and Russia, and demanded the delivery of the Danish fleet to England, under a solemn stipulation of its being restored on the termination of our war with France. The Danes, justly offended at this proposal, and aware that their agreeing to it would expose them to the loss of the continental part of their territory, refused; our envoy returned on board our fleet; our army was landed, and Copenhagen invested August 1[illegible]
by sea and land, while a part of our fleet cut off all communication between the Continent and the island on which it stands. After a fortnight passed in preparations, a heavy fire was opened on the city, and Sept. 2.
continued during two days with great effect. A capi- Sept. 8.
tulation now took place; the citadel, dock-yards, and batteries were put into our hands, and no time was lost in fitting the Danish men of war for sea. All stores,

Expedition to Copenhagen, A[illegible] 1807.

War with France and her Allies.

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War with France and her Allies.

timber, and other articles of naval equipment, belonging to government, were taken out of the arsenals, embarked and conveyed to England.

The expedition to Copenhagen excited much discussion and difference of opinion in England, * particularly when it was avowed that ministers had no evidence of an intention in Russia to coerce Denmark, and still less of a disposition in Denmark to give way to such coercion. The only tenable ground was, to acknowledge at once that the Danes had given no provocation; that their conduct had been strictly neutral; but that they would evidently have been unable to defend themselves, had Russia and France united against them. Still it was extremely questionable, whether we, to ward off a contingent annoyance, should commit a present aggression. The success of our attempt, considering our naval superiority, the insulated position of Copenhagen, and its unprepared state, admitted of little or no doubt. But this was not all. There remained farther and more important considerations;—the odium that would be thus excited against us in the Danish nation, and that closer approximation of Russia to France, which could hardly fail to follow so open an affront to a power professing to take a lead in the political arrangements of the Baltic.

Buenos Ayres.

The Cape of Good Hope surrendered to an armament from England in January 1806. After this, Sir Home Popham, who commanded the naval part of the expedition, ventured to make, without the sanction, or even knowledge of government, an attempt on Buenos Ayres. Our troops, though under 2000 in number, effected a landing, and occupied the town. Intelligence to this effect having reached England, the popular notion, that Buenos Ayres would prove a great market for our manufactures, induced government to take measures for completing the new conquest. And, though the inhabitants soon rose, and drove out the feeble detachment under Sir Home Popham, an armament, which arrived in January 1807, under the command of Sir Samuel Auchmuty, attacked the fortified town of Monte Video, and carried it in an assault, conducted with great skill and gallantry. But a very different fate awaited our next enterprise,—an assault on Buenos Ayres, planned by General Whitelocke, an officer wholly unfit for such a service. Our troops, 8000 in number, were successful in some parts; but failing in others, the result was a negotiation, and a convention that we should withdraw altogether from the country, on condition of our prisoners being restored.

June 27, 1806.

July 5.

Battle of Maida.

But, in another part of the world, and against an enemy in general far more formidable, our arms had been attended with success. Naples had been engaged in the coalition of 1805, with a view to assail the French on the side of Lombardy; but an Anglo-Russian army, landed for that purpose, had been prevented from marching northward by the disastrous intelligence from Germany. They were subsequently re-embarked, the British withdrawing to Sicily, and Palermo becoming once more the refuge of the Neapolitan court. That court, eager to excite insurrection against the French in Calabria, prevailed on General Sir John Stuart, in the beginning of July 1806, to lead thither a detachment of our troops. They landed, and soon after received intelligence, that at Maida, distant only ten miles from our encampment, was a French corps, already nearly equal to our own, and hourly expecting reinforcements. Our troops marched to attack them on the morning of 4th July, and at nine o'clock drew near to their position, which had a river in front. General Reynier, who commanded the French, having received his reinforcements the preceding evening, and seeing that our small army was unprovided with cavalry, made his men march out of their camp, and advance to charge us on the plain. Our force, including a regiment landed that morning, was nearly 6000; that of the enemy above 7000. The French, who knew our troops only by report, marched towards them with confidence, and hardly expected them to stand the charge. Our line formed, faced the enemy, and advanced. The firing commenced at the distance of about 100 yards; but it had not long continued, when the extreme of each line, as if by mutual consent, suspended it, and advanced towards the other with fixed bayonets. The advancing division on each side was composed of choice troops. On our side, of light companies; on that of the French, of grenadiers. They crossed bayonets, and were about to begin a conflict hand to hand, when the firm aspect of our men daunted their opponents. The French gave way, and were pursued with great slaughter. The rest of the enemy's left now drew back, but at first in good order; for they stopped occasionally, fired, and retreated only as our troops drew near; at last they fell into great confusion. Their right flank being in like manner repelled in an attack on our left, the field of battle remained entirely in our possession. The French loss in killed and wounded was nearly 2000; ours only between 300 and 400. This brilliant exploit produced the evacuation of part of Calabria by the French, but had no other result; our small force returning soon after to Sicily.

Threatened attack on Constantinople.

Our next operation in the Mediterranean was an unsuccessful menace of the Turkish capital. That court refusing to enter into our plans of hostility to France, our ambassador withdrew, and re-entered the Straits of the Dardanelles, with a squadron of seven sail of the line, exclusive of frigates and bombs. They suffered considerably in passing the narrow part of the straits, between the ancient Sestos and Abydos, now called the castles of Romania and Natolia. Anchoring at a distance of eight miles from Constantinople, our Admiral, Sir J. Duckworth, threatened to burn the Seraglio and the city, but in vain. The Turks continued adverse to our demands, and employed the interval assiduously in strengthening the formidable batteries of the Dardanelles. It soon became indispensable to withdraw, and to repass the straits; but this was not accomplished without a loss of 25 men in killed and wounded, the cannon at the castles being of

* See the *Parliamentary Debates* on this expedition.

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great size, and discharging granite balls. A descent made soon after in Egypt was equally unfortunate. A detachment of troops landing at Alexandria, occupied that town, but suffered a severe loss at Rosetta, and eventually withdrew, on the Turks consenting to give up the prisoners they had taken. Peace was soon after concluded with the Turks, and our operations in the Levant confined to the capture of the Ionian Islands from the French. Zante, Cephalonia, Ithaca, and Cerigo, were taken by a small expedition in 1809, and Santa Maura the succeeding year.

March 1807.

Sicily.

On the side of Sicily, our commanders, though pressed by the court of Palermo, refused to make descents on Calabria, which could lead to nothing but partial insurrections, followed, on the return of a superior force, by the death of the most zealous of our partisans. We took, however, in June 1809, the small islands of Ischia and Procida, near the coast of Naples; and, in the autumn of 1810, repelled an attempt of Murat to invade Sicily. A body of nearly 4000 Italians, who had landed on this occasion, were driven back with loss—a failure which, joined to our decided naval superiority, put an end to all attempts of the kind.

September 1810.

Sweden.

The hostility of Russia consequent on her connection with France, produced a menaced invasion of Sweden, now our only ally in the north. To aid in repelling it, Sir John Moore was sent to Gottenburgh with a body of 10,000 men. This force did not land; but the general, repairing to Stockholm, entered into communications with the king, and had the mortification of finding that prince wholly incapable of rational conduct, and bent on projects which would necessarily involve the sacrifice of the British troops. On this he lost no time in returning to Gottenburgh, and soon after brought back the armament to England, to be employed on a more promising service.

May 1808.

Portugal and Spain.

The influence possessed by Bonaparte over Spain had long inspired him with the hope of overawing Portugal, and of obliging that country to dissolve her alliance with England. To this hope the humiliation of Germany, and his new alliance with Russia, gave double strength; and, in the latter part of 1807, the most peremptory demands were made on the court of Lisbon. To part of these, implying the exclusion of British merchantmen from the harbours of Portugal, compliance was promised; but the demand of confiscating English property, or detaining the English resident in Portugal, was met with a decided refusal. A French army now marched towards Lisbon, and threatened openly to overthrow the house of Braganza; but the latter, after some momentary indications of indecision, took the determination of abandoning their European dominions, and proceeding to Brazil. This spirited, and by many unexpected measure, was carried into effect in the end of November, and Lisbon was forthwith occupied by French troops. A few months after the transactions at Bayonne occurred, and the general declaration of hostility by the Spaniards to Bonaparte. Our cabinet now determined to postpone all other projects to that of a vigorous effort on Spain and Portugal. With that view, an armament of 10,000 men collected at Cork, and said to be intended for Spanish America, sailed in July to the Peninsula, and offered its co-operation to the Spaniards in Galicia. They, however, thought it best that we should confine our aid to Spain to arms and money, directing our military force against the French army in Portugal. Accordingly, our troops, after passing an interval at Oporto, were landed to the southward, in Mondego Bay, where, after receiving the co-operation of a farther division of British, and of a few Portuguese, they proceeded on their southward march to Lisbon. The first actions took place with French detachments at the small town of Obidos, and at Roleia. Neither were of importance: the French, inferior in number, retreated; but their commander at Lisbon was Junot, an officer trained in the school of revolutionary enterprise, and disposed, like most of his brethren at that time, to make light of British land forces. He determined forthwith on offensive operations, advanced from Lisbon, and, reaching the British army on 21st August, attacked it in its position at the small town of Vimiera. The force on either side * was about 14,000 men. The French marched to the onset in columns, with their wonted confidence, but they had to encounter an enemy equally firm as Germans or Russians, and far superior in arms, equipment, and activity. A part of the opposing lines advanced to the charge, and not only crossed bayonets, but, what very rarely happens, maintained that desperate conflict for several minutes, when the French gave way. Equal success attended our efforts in other parts of the line, and the loss of the enemy was 3000 men, and 13 pieces of cannon. The object now ought to have been to follow up our success, before the French should recover themselves, and fortify the almost impenetrable mountains on the road to Lisbon. In vain did Sir A. Wellesley † urge this, first on Sir H. Burrard, who had now taken the command, and next day on Sir H. Dalrymple, who arrived and replaced him. Reinforcements were daily expected; and, till their arrival, neither of these officers could be persuaded to incur hazards for the attainment of an advantage which, from their unacquaintance with localities, they were not competent to appreciate. A precious interval was thus lost. The French occupied the passes, opened their negotiation in a tone of confidence, and obtained, by the treaty called the Convention of Cintra, a free return to France on board of British shipping. The ministry, though disappointed, determined to defend this Convention; judging it indispensable, partly from the communications of Sir H. Dalrymple, more from its bearing the unqualified signature of Sir A. Wellesley, who was, even then, their confidential military adviser. The public, however, called for inquiry;

War with France and her Allies.

1807.

August 15.

Battle of Vimiera.

Convention of Cintra.

* Report of the Board of Inquiry into the Convention of Cintra.

† See the Evidence before the Board of Inquiry.

War with France and her Allies.

ministers felt the necessity of acceding; the three generals were ordered home from Portugal; and, after a long investigation, and divided opinions, the chief error was found to lie in the loss of the twenty-four hours which followed the battle of Vimiera.

The public disappointment at the Convention of Cintra was soon counterbalanced by gratifying intelligence from the Baltic. Bonaparte, whose plan was to subjugate all Europe, by making one nation instrumental in overawing another, had sent the Spanish regiments in his service into Denmark; but he could not prevent their receiving intelligence of the rising spirit of their countrymen, and the vicinity of a British fleet happily facilitated their evasion. Ten thousand Spaniards were thus brought off, and carried, with their arms, stores, and artillery, to join the standard of their country.

Sir John Moore's campaign.

Meantime the command of our troops in Portugal was vested in Sir John Moore, and arrangements were made for moving them forward into Spain. From the badness of the roads, it was necessary to advance in two divisions, one marching due east, and another north-east, while a farther force, arrived from England at Corunna, was instructed to hold a south-east course. Each of the lateral divisions received, in their progress, orders to adapt the direction of their march to existing circumstances; but the result was, that both converged towards the central division, led on by Sir John Moore in person.

In their march, our officers had an ample opportunity of witnessing the fallacious and exaggerated impressions entertained in England with regard to the ardour of the Spaniards. They saw a country wretchedly cultivated and thinly peopled; a nation hostilely disposed, indeed, to the French, but unaccustomed to exertion, and incapable of combination; instead of recruits, supplies of provisions, or offers of voluntary service, all was inactivity and stagnation; and, amidst the general poverty, our Commissariat had great difficulty in obtaining provisions. Another great source of perplexity was the want of information. The natives, whether in the civil or military service, were too ignorant and credulous to be capable of detecting exaggeration, or of distinguishing truth from falsehood; and our officers were obliged to judge for themselves under the most contradictory rumours.

Sir John Moore reached Salamanca on 13th of November, aware that the Spaniards had been defeated at Burgos, and soon after apprised that a French corps was advancing to Valladolid, within 60 miles of his front. In this situation, he received from Madrid the most urgent solicitations to send thither his army, in whole or in part. He knew the ardour of his country for the cause of Spain, and directed his movements in the plan of complying, as far as should be at all advisable, with the representations pressed on him; but, day after day, the intelligence became more discouraging. At last, the fall

Dec. 4.

of Madrid, ascertained by an intercepted letter of General Berthier, removed every doubt, and left him no other plan but that of uniting his three divisions, and determining on a retreat; but, as his army was

Dec. 20.

now augmented to 25,000 men, he determined to strike, if possible, a blow against the detached French army under Soult, stationed at some distance to the north-east. With this view, our troops advanced from the small town of Sahagun towards the enemy, and a partial action, which took place between the opposite vanguards, was to our advantage; but intelligence arriving that Bonaparte was directing a superior force on our rear, it became indispensable to make a prompt and uninterrupted retreat. Bonaparte, pressing forward with his vanguard, reached our rear at Benavente, saw, for the first time, British soldiers, and witnessed a cavalry action, in which several squadrons of his guard were very roughly handled, and their commanding officer, Lefevre Desnouettes, made prisoner. Meanwhile, Soult, marching by a different road, hoped to cross our line of retreat at Astorga; and the Spaniards having abandoned the position which covered the access to that town, it required both prompt and skilful exertion to enable our army to occupy it before the enemy. Here, pressed as we were, it became necessary to destroy a great part of our camp equipage.

Dec. 29.

Our army was a-head of the enemy, but had before it a long and difficult march over the mountains of Galicia. The weather was severe, provisions scanty, the inhabitants cold and unfriendly: so many privations and disappointments relaxed the discipline of our soldiers, who called loudly to be led to action, as the close of their distress. Retreat, however, was unavoidable; and, in this state of suffering and insubordination, the army performed a march of more than 200 miles, our general keeping in the rear to check the French, who followed with their usual audacity. At Lugo, about 60 miles from Corunna, circumstances seemed to justify our awaiting the enemy, and fighting a general battle. Our soldiers repaired with alacrity to their ranks, but Soult did not accept the challenge, and our retreat was continued. It closed on the 12th January, having been attended with the capture of many men, from disorder, and the sacrifice of many horses, from want of forage, but without losing a standard, or sustaining a single check in action. On the 13th, 14th, and 15th, the sick and artillery were embarked on board our men of war; the troops remained on shore, to await the enemy, and to cover the reproach of retreat by some shining exploit. This led to the battle of Corunna: on that day our position was good on the left, but very much otherwise on the right; thither, accordingly, the French pointed their strongest column, and thither Sir John Moore repaired in person. He directed the necessary movements first to obstruct, and afterwards to charge, the advancing enemy. These orders were gallantly executed, and the attack of the French repelled; but our lamented general received a wound from a cannon ball, which soon after proved mortal. Subsequent attacks, first on our centre, and next on our left, were equally foiled; and, in the evening, we occupied an advanced position along our whole line. Enough having now been done for the honour of our arms, the embarkation was continued on the 17th, and completed on the 18th, after which the whole set sail for England.

Jan. 16.

Campaign of 1809.

Our failure in this campaign was far from discouraging our government from new efforts. Austria was preparing to attack the allies of Bonaparte

War with France and her Allies.

in Germany, and the Spaniards, though repeatedly beaten in close action, continued a destructive warfare in the shape of insulated insurrections. Sir Arthur Wellesley was accordingly sent with a fresh army to Lisbon, and General Beresford with a commission to discipline the Portuguese forces. They found the French threatening Lisbon in two directions; from the east, with a powerful force under Victor; from the north, with a less numerous body under Soult. Sir Arthur Wellesley advanced against the latter, drew near his rear guard on the banks of the Douro, drove it over that river, and crossing immediately after, forced Soult to a precipitate retreat from Oporto. Returning to the southward, our commander obliged the force under Victor to draw back; and having, some time after, effected a junction with a Spanish army, took the bold determination of moving forward in the direction of Madrid. The French now sent reinforcements to the army of Victor, and the opposing forces met at Talavera de la Reyna, a town to the north of the Tagus, near the small river Alberche. The British force was 19,000; that of the Spaniards above 30,000; the French army amounted to 47,000.* Lord Wellington was too distrustful of the discipline of his allies to venture an attack on the French, but he saw no imprudence in trying, as at Vimiera, the chance of a defensive action. Stationing the Spaniards on strong ground on the right, he occupied with the British a less strong, but yet favourable position, on the left. Against the army thus posted, the French advanced in the afternoon of 27th July, driving in our van, and attacking an eminence on our left. This eminence, the key of the position, would have been assailed from the beginning, by Bonaparte, with a formidable column, but the rifle corps and single battalion sent against it by Victor were soon driven back by our troops. A second attack, made in the evening by three regiments of infantry, was at first successful, but it was soon repelled by a fresh division of British. The main body of the French, surprised at this failure, waited impatiently for morning to renew the attack; they advanced, marched through a destructive fire to the top of the rising ground, approached our cannon, and were on the point of seizing them, when our line rushed forward with the bayonet, and drove them down with great loss. Their commanders now determined to suspend all attacks on the Spaniards, and to bring a mass of force against the front and flank of the British. A general attack took place at four in the afternoon, and the troops directed against the height, now consisted of three divisions of infantry, or about 18,000 men. Crossing the ravine in their front, the first division scaled the height amidst volleys of grape-shot; but its general fell, a number of officers shared his fate, and retreat became unavoidable. No attempt was now made to carry the eminence in front; attacks were made on its left and right, but all were ineffectual. Our greatest loss was sustained in an unsuccessful attack by our cavalry on two squares of French infantry in the plain; the 23d light dragoons were here almost annihilated. The loss of the Spaniards was only 1200; that of the British above 5000; that of the French (De Rocca's *Memoirs*) nearly 10,000.

May 12.

Battle of Talavera.

Notwithstanding this signal success, it became necessary for the allied army to retire; the French divisions, in the north-west of Spain, having united and begun to march in a direction which would soon have brought them on our rear. Our army crossed the Tagus, and held a south-west course till reaching Badajos, where it remained during the rest of the year, in a position which covered that fortress, and showed the Spaniards that we had not abandoned their cause, however dissatisfied with their co-operation, and convinced of the impracticability of combining offensive operations with such allies.

Attack on the French Fleet in Basque Roads.

While, by land, the fortune of war was thus chequered, at sea the French experienced nothing but disasters. Eight ships of the line in Brest, eluding our blockade, sailed southward to Basque Roads near Rochefort, where they were joined by four sail of the line from that port. Our fleet blockaded them in their new station, and preparations having been made to attempt their destruction by fire-ships, Lord Cochrane sailed in with these dreadful engines on the evening of the 11th April 1809. Our seamen broke the boom in front of the French line, disregarded the fire from the forts, and, after bringing the fire-ships as near to the enemy as possible, set fire to the fusées and withdrew in their boats. The French, surprised and alarmed, cut their cables and run on shore. Four sail of the line that had accompanied Lord Cochrane attacked them, and though the main body of our fleet was prevented by the wind and tide from coming up, the result of our attack, and of the effect of the fire-ships, was the loss of four sail of the line, and one frigate burned or destroyed. At a later period of the year, a French convoy of three sail of the line and eleven transports, proceeding from Toulon to Barcelona, was attacked and destroyed by a division from Lord Collingwood's fleet. October 25

Movements of Austria.

Doubtful as was the aspect of the great contest in Spain, it employed a large portion of Bonaparte's military establishment, and revived the hope of independence in Germany. Prussia was too recently humbled, and too closely connected with Russia, at that time the ally of France, to take up arms; but Austria was unrestrained, and thought the season favourable for a renewal of the contest. Her troops took the field in April, and invaded Bavaria, under the Archduke Charles, but were worsted at Eckmuhl, and Vienna was a second time entered by Bonaparte. His impatience to attack the Austrian army on the north side of the Danube, led to his failure in the sanguinary battle of Aspern; and necessitated the advance of almost all his regular troops into the heart of Germany, at a distance of several hundred miles from the coast.

May 13.

May 21, 22

Expedition to the Scheldt.

Of the naval stations thus exposed, by far the most important was Antwerp, situated on a part

* See *Mémoires sur la Guerre des Français en Espagne*. Par M. De Rocca, Chevalier de l'Ordre de la Legion d'Honneur. 8vo. 1815.

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of the Scheldt, of as great depth, and as accessible to ships of the line as the Thames at Woolwich. From Antwerp to the mouth of the Scheldt is a distance of about 50 miles. The first fortified town, on coming in from the sea, is Flushing, the batteries of which, though formidable, are not capable of preventing the passage of ships of war through a strait of three miles in width. Our armament, consisting of nearly forty sail of the line and 38,000 military, was the most powerful that ever left our shores. It crossed the narrow sea with a fair wind, and, in the morning of 30th July, the inhabitants of the tranquil coast of Zealand were astonished by an unparalleled display of men of war and transports. Our troops landed and occupied forthwith Walcheren and the islands to the north. No resistance was offered except at Flushing; and our commander, the Earl of Chatham, showed himself wholly incapable of discriminating the causes of success or failure, when he stopped to besiege that place; it ought only to have been watched, while the main body of the troops should have landed in Dutch Flanders, on the south of the Scheldt, and marched straight to Antwerp, which, even with artillery, might have been reached in a few days. The French, never doubting the adoption of this plan, and conscious of their weakness, had moved their men of war up the river, beyond the town, previous to setting them on fire. But a delay of a fortnight took place before Flushing, and time was thus given to the enemy to strengthen the forts on the river, and to collect whatever force the country afforded. Still, as an attack by water was not indispensable to success, there yet remained a chance; ten days more, however, were lost; the relinquishment of the main object of the expedition became unavoidable, and the only farther measure was to leave a body of 15,000 men in the island of Walcheren. There, they remained during several months, suffering greatly from an unhealthy atmosphere, and doing nothing except destroying,
December 9. on their departure, the dockyards of Flushing. Never was a gallant force more grossly misdirected; the choice of our general was as unaccountable as the choice of Mack in 1805; and the historian, were he to reason from the inferior numbers of the enemy, might pronounce this expedition as inglorious to our arms as the battles of Poitiers and Agincourt to our enemies of a former age.

Campaign of 1810 in Portugal.

We turn, with impatience, from the banks of the Scheldt to a scene more honourable to our arms. Our troops, under (Sir A. Wellesley) Lord Wellington, had passed the winter in the interior of Portugal, moving northward as spring advanced, but delaying active operations: offensive war was unsuited to our situation, and the French awaited reinforcements from the north. Bonaparte's determination now was to make Massena penetrate into Portugal, and to expel those auxiliaries who were the main spring of the obstinate resistance experienced by him in Spain. The first enterprise of the French army was the siege of the frontier fortress of Ciudad Rodrigo, which surrendered on 10th July. The next object of attack was the Portuguese fortress of Almeida,
August 27. which was invested in the end of July, and taken unfortunately too soon, in consequence of the explosion of the magazine. Soon after, the French army, now a formidable body, advanced into Portugal, Lord Wellington retiring before them, but determined to embrace the first opportunity of fighting Sept. 16.
on favourable ground. This occurred when occupying the highest ridge of the mountain of Busaco, directly in face of the enemy. The French, always impetuous, and not yet aware of the firmness of our Sept. 27.
men, marched up the mountain; one division reached the top of the ridge, where they were immediately attacked by a corps of British and Portuguese, and driven from the ground. In other parts the same result took place before the French reached the top. The loss on our side was 1000 men; that of the enemy between 2000 and 3000. Massena desisted from farther attacks, but, turning the flank of our position, Lord Wellington necessarily retreated in the direction of Lisbon, till he reached the ground where he had determined to defend that capital.

The tract of country to the north of Lisbon is not above twelve miles in breadth, having the sea on the west and the Tagus on the east; the ground is extremely mountainous, and accessible only by passes, which were occupied by our troops and batteries. Massena felt all the strength of this position, and the repulse at Busaco made him beware of a second encounter on disadvantageous ground. It was now for the first time that the impetuous bands of Bonaparte stopped short in their career; the armies remained opposite to each other above four months, during which the French were greatly straitened for provisions and forage, being obliged to get convoys of biscuit under escort from France, while the command of the sea procured abundance to the British. Still Massena persisted in keeping his position, hoping to combine his operations with the army of Soult, advancing from the south-east of Spain,—an army which was but too fortunate, having attacked and taken by surprise a Spanish camp on the Feb. 19,
banks of the Guadiana. A number of boats had 1811.
been constructed by Massena to cross the Tagus and co-operate with Soult, but in the beginning of March, intelligence arrived that a convoy of biscuit long expected from France had been intercepted by the Guerillas. There was now an end to all offensive projects, and there remained only the alternative of retreat; it began on 5th March; the British followed, and the movements of either army, during a very long march, afforded an admirable exemplification of the rules of war. Our advance was so prompt, that the French were often obliged to move hastily from one position to another; but they kept their best troops in the rear, collected in solid bodies, and affording no opening to our vanguard. The retreat lasted a month, and closed near Almeida on the frontier of Spain. The French, however, were soon again in a condition to act, and advanced to relieve Almeida, of which we had now begun the siege: the chief fighting took place on 3d and 5th May, near a village called Fuentes d'Honore, but all their efforts were ineffectual, and Almeida was left to its fate: the chief part of the garrison, however, found means to escape by a nocturnal march.

Retreat of Massena.

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Battle of Barrosa.

Meanwhile the south, or rather the south-west of Spain, was the scene of very active operations. A body of Spaniards and British, marching northward from Gibraltar, approached the south-west extremity of the line occupied by the French troops engaged in the blockade of Cadiz. General Graham commanded the British, and on 5th March, at noon, was drawing near to the close of a long march, when he received intelligence of the advance of a French force. Knowing the height of Barrosa, which he had just left, to be the key of the position, he immediately countermanded his corps, and had proceeded but a short way, when he found himself unexpectedly near to the enemy, whose left division was seen ascending the hill of Barrosa, while their right stood on the plain within cannon shot. To retreat was wholly unadvisable; an immediate attack was determined on, though unsupported by the Spaniards, and inferior to the enemy. A battery opened against the right division of the French, caused them considerable loss, but they continued to advance, until a charge with the bayonet drove them back with great slaughter. With the other division on the ascent of the hill, there took place a similar conflict with a similar issue; both sides fought with courage, and both sustained a heavy loss; that of the British was above 1200; that of the enemy nearly double. The action lasted an hour and a half: our success was owing partly to the effect of our guns, but more to the firmness of the troops, who showed themselves determined rather to fall than yield.

About the same time, but at a distance of 200 miles to the north of Cadiz, the important fortress
March 10. of Badajos fell into the hands of the French. This painful intelligence reached Lord Wellington when following up the retreat of Massena; and no time was lost in detaching a body of troops to the south of Portugal to enable Marshal Beresford to advance and form the siege of Badajos. This called from the south the army of Soult, 20,000 strong; on their approach, Marshal Beresford raised the siege of Badajos, and marched to meet the French near the river Albuhera, or Albuera, with a force numerically superior, but among which there was only 8000 British.

Battle of Albuera.

Our army awaited the attack in a position as good as a country, in general level, afforded; but our general, in an evil hour, entrusted to the Spaniards a rising ground which formed the key of that position. The French columns succeeded in driving them from it, and were about to rake with their field-pieces all the allied line. A British division marching to attack the enemy with the bayonet, were unfortunately turned by a body of lancers, who, amidst the smoke from the firing, had approached unperceived. Our loss was very great here, and there remained only one fresh division, which advancing gallantly to the charge, and, being supported by the other corps, drove the French with great slaughter from the field. The battle lasted five hours, and so great was the loss, that of the British force engaged, nearly one half were killed or wounded: the French had fought with equal bravery, and their loss also was very great. Lord Wellington reached the army some time after, and determined to renew the siege of Badajos; breaches were made in the walls, and two attempts at assault were hazarded (6th and 9th June), but in vain; the advance of the French army from the north, in concert with that of the south, necessitated the raising of the siege. Here ended the active operations of the year; our army remained some time encamped in the central part of Portugal, after which Lord Wellington marched northward and threatened Ciudad Rodrigo, but retreated before a superior force collected by the French.

Campaign of 1812.

The campaign of 1812 commenced very early, Lord Wellington investing Ciudad Rodrigo on 8th January. The siege was pressed with activity, and a breach being made, the town was carried by storm on 19th January, though with a great loss, particularly in officers, among whom was General Mackinnon. So prompt had been our operations, that the French army approaching to the relief of the place, would not at first believe its capture. Soon after, Lord Wellington turned his forces to the south and invested Badajos, already the scene of such obstinate contests. Here, also, the operations were pressed with great rapidity, that they might be brought to an issue before the arrival of the French army from Cadiz. On the night of 6th April, Badajos was attacked on several points by escalade; but we were repulsed in every direction except at the castle, which was fortunately carried, and, commanding all the works, the consequence was the surrender of the town next day, after a siege which, short as it had been, cost us very nearly 5000 men. Secure on the south, Lord Wellington now marched towards the north, and detached Sir Rowland Hill to make a sudden attack on the French station at Almaraz, where the bridge over the Tagus served as the chief military communication between the northern and southern army. The expedition was successful, the entrenchments being stormed and destroyed. Lord Wellington now May 19. marched against the French army in the north, commanded by Marmont, and reached Salamanca on 16th June. The forts in that town being taken after some sharp fighting, the French retreated to the Douro, but being soon reinforced, resumed the offensive, and obliged our army to retreat in turn. These movements continued several weeks, Lord Wellington being obliged to yield ground to his opponent, but ready to attack him on the commission of any material fault. Such an opportunity at last occurred on 22d July, near Salamanca, when the French, rendered confident by our continued retreat, extended their left, and presented an opening, which was instantly seized by their vigilant adversary.

Battle of Salamanca.

Columns were sent forward against the enemy's left and centre; the former succeeded completely, the latter met with much opposition. Great gallantry was shown, and heavy loss sustained, on both sides; at last the French centre and right were both driven from the field. The darkness prevented our making prisoners, but a body of cavalry joining in the night, the hostile rear-guard was attacked next morning, and obliged to surrender. Our loss was about 3000 British and 2000 Portuguese, that of the enemy in killed and wounded was at least equal, and we took between 6000

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and 7000 prisoners. The British force in the field was 22,000.

The consequences of the victory of Salamanca were the pursuit of the French army; the occupation of Madrid on 12th August by the allies; the abandonment by the French of the works constructed with vast expence against Cadiz; the evacuation of Andalusia, Granada, and all the south of Spain. But as this loss of territory was not attended by a loss of troops, it became incumbent on Lord Wellington to prepare against a vigorous attack from forces that were rapidly concentrating. He made repeated attempts to take the castle of Burgos and the military stores collected there, but this fort, defended by a strong garrison and a vigilant commander (General Dubreton), baffled all our efforts, and proved the cause of a considerable sacrifice of lives. Meantime, the approach of Soult from the south, and of the army that had fought at Salamanca from the east, obliged Lord Wellington to adopt the alternative of retreat. He began on 20th October, and proceeded westward, in a line nearly parallel to the Douro, taking above three weeks to recross the country to the scene of his victory at Salamanca. There, united with General Hill, and at the head of 50,000 men, he remained on ground lately so propitious; hoping that an opportunity might offer to attack the enemy, though now increased, by the junction of their two armies, to the number of 70,000. But Soult's positions were found too strong for attack, and the interval afforded him by Lord Wellington was diligently employed in pushing forward detachments to cut off our communications with Portugal. Retreat now became indispensable; and here, amidst hasty marches, and a scarcity of five days, there occurred scenes of insubordination which recalled all the disorders of our march to Corunna, and drew from Lord Wellington a most severe censure in general orders. Fortunately, similar privations on the side of the French prevented them from making many prisoners, and, on 20th November, on the frontier of Portugal, was closed this eventful campaign.

August 25.

Operations in the East of Spain.

The campaign of 1813 opened in the east of Spain, by an attack on the allied army under Sir John Murray, stationed not far from Alicant; the ground it occupied was strong, but the length of the position, two miles and a half, made Suchet, who commanded the French, conceive the hope of penetrating it at one or other point. In this, however, he was foiled with a loss of from 2000 to 3000 men; the only check of importance received by that commander in all his campaigns in Spain. Soon after this success, our army was engaged in the bold plan of proceeding by sea to Catalonia and besieging Tarragona. The wind proved favourable; the main body was landed near Tarragona, and a detachment succeeded, by great exertion, in taking fort St Philip on the mountain called the Colde Balaguer, which blocked the nearest road for the arrival of the French from the south. Suchet, however, lost no time in marching northwards; and our general, Sir John Murray, considered his force (which was chiefly Spanish) unable to withstand the French; he therefore embarked and returned to Alicant, a measure which incurred censure, but appears fully justified by circumstances, and still more by the conduct of his successors in the command.

June 3.

Suchet, though successful on this occasion, soon found himself unable to retain his extensive line of occupation. The battle of Vittoria brought a new enemy on his rear, and obliged him to withdraw first from Valencia, and subsequently as far as Barcelona. Our army now advanced by land, and resumed the siege of Tarragona, with the power of retreating, not as before by sea, but on the country behind; an alternative to which a second advance by Suchet soon compelled our new commander, Lord William Bentinck. The French, however, unable to occupy an extended position, blew up the works of Tarragona and retired. Our army advanced anew, but was again checked and obliged to draw back, exhibiting a striking proof of the impracticability of opposing an active enemy with a mixed force, of which the Spaniards formed a large proportion.

Sept. 12.

Operations in the West.

We now turn to the western part of the peninsula, the field of the commander-in-chief, and of the far larger portion of our force. Lord Wellington, averse to open the campaign till every part of his troops was ready to co-operate with efficiency, did not move from quarters till after the middle of May. He knew that he would have much ground to traverse, retreat being evidently the policy of the French, weakened as they were by the recall of 25,000 veterans, who had been feebly replaced by a body of conscripts. Lord Wellington was now, for the first time, at the head of a superior force, which he wielded with consummate skill. The strength of the enemy lay in the line of the Douro, which they expected to defend with advantage, so far at least as to make us purchase dearly its acquisition; but all this was prevented by Lord Wellington making his left division cross the river on the Portuguese territory, and advance along its northern bank; while he and Sir Rowland Hill, at the head of separate corps, marched, after several feints, in a diagonal direction, so as to support this movement, and effect a junction in an advanced position. The French, threatened with being taken in the rear, evacuated one town after another, and, even at Burgos, declined to fight on ground where late recollections would have been so animating; they continued to retreat, increasing from time to time their numbers by the garrisons of the evacuated towns, until, at last, they took a position at Vittoria, a town in Biscay, near the northeast frontier of Spain.

Battle of Vittoria.

The position of the French extended from north to south, and was of great length. Their left rested on heights; part of their centre was also on heights, and their right was near the town of Vittoria. The Zadora, a stream of considerable size, but crossed by several bridges, ran nearly parallel to their front. Both armies were numerous, particularly that of the allies. It was the first time that nearly 40,000 British had fought together in Spain. Lord Wellington acted on the offensive throughout, and began the operations by taking possession of the heights near the extreme left of the enemy. This was easily

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effected; but their importance being soon perceived by the French, an attack was made to recover them. An obstinate contest took place, but the British on the heights repelled every assault. Under cover of these heights our right wing advanced, and took a village (Sabijana) in front of the enemy's centre. It was in vain the French attempted to retake this village. The centre of the allies crossed the river near it, and the centre of the French withdrew from their position, retreating to the town of Vittoria. At first this retreat took place in good order, but an alarming account was soon received from the French right. That part of their position had been defended by the river and two *têtes de pont*, but the troops of our left wing had taken, first the heights commanding these forts, and soon after the forts themselves, baffling every effort of the enemy to retake them. The great road leading to the north was thus in possession of the allies; hence a general alarm and confusion throughout the French army. Their reserve was hastily withdrawn from its position, and pressed, with the whole army, along the only remaining road to the eastward; abandoning all their artillery, their ammunition, and their baggage. The loss of the battle was imputed by the French to Jourdan, whom Bonaparte, in a luckless hour, had allowed his brother to substitute to Soult; and who here, as at Talavera, was too late in discovering the importance of commanding positions. The loss in men was not particularly severe; that of the allies in killed and wounded was under 4000, and that of the French probably not much greater. The temptation afforded by the plunder of the baggage prevented our troops from making many prisoners; but the spirit of the enemy was shaken, and the loss of their artillery and stores obliged them to retreat across the Pyrenees.

The next operation of consequence was the siege of San Sebastian, a frontier fortress of great importance, which the French made the most vigorous efforts to relieve. Their army, provided anew with ammunition and cannon, advanced under command of Soult, and drove back, after some sharp actions, the British corps posted in the passes of the Pyrenees. Our troops retreated to the vicinity of Pamplona, where, on the 27th, and still more on the 28th, they sustained a succession of impetuous attacks from the enemy. On the 29th Lord Wellington resumed the offensive, drove the French from their position, strong as it was, and obliged them to retrace their steps through the Pyrenees. Our loss in these actions was about 6000 men in killed and wounded; that of the enemy was still greater, exclusive of 4000 prisoners.

July 24.

Battles near Pamplona.

At San Sebastian we had been repulsed in an assault on 25th July; the siege was continued, and a final assault on 31st August led to the capture of the place, though with the loss of 2500 men. The farther operations were the entrance of our army on the French territory on 7th October; the capitulation of Pamplona on the 26th, and a general attack on the position of the French near St Jean de Luz on 10th November, after which they retreated across the Nivelle. But this mountainous country afforded a number of positions, and our next task was to drive the enemy from behind the Nive, a large river flowing northward from the Pyrenees. This was partly accomplished on 9th December; but on several succeeding days the French, commanded by Soult, made impetuous attacks on the allied army, all anticipated by Lord Wellington, and all repulsed with heavy loss. Still the rains of the season, and the size of the mountain streams, retarded our operations. In January (1814) our army made some farther progress, and, on 25th February, attacked the French in a position near Othes, behind the Gave de Pau, another large river flowing from the Pyrenees. This attack was successful; and the retreat of the French was followed by the desertion of a number of their new levies. Soult's army now drew back, not in a northerly but easterly direction, to join detachments from the army of Suchet in Catalonia. At Tarbes, on 20th March, the fighting was of short duration, but a sanguinary battle took place at Toulouse, on 10th April;—a battle attended with a loss to the allies of nearly 5000 men, which, as well as a great sacrifice of lives on the part of the French, might have been prevented, had earlier intelligence arrived of the overthrow of Bonaparte, and the change of government at Paris.

War with France and her Allies.

Battle of Toulouse.

The causes of this great change have been already explained in the concluding Section of our article France. They are but partly to be found in the operations described above; for though the Spanish war had proved extremely injurious both to the finances and military establishment of Bonaparte, his power was so great, that nothing could have shaken it but a vast and sudden catastrophe. From the moment that he lost his armies in Russia, there existed substantial grounds for hope; and after the accession of Austria to the coalition, there was little reason to doubt his overthrow. The resources of France continued indeed unreservedly at his disposal; and the dread of a counter-revolution gave him the support of the majority of a nation long disgusted with his domineering spirit and never-ending wars; but the preponderance of military means was irresistible; in vain did he struggle against it in Saxony in 1813, and in Champagne in 1814. His partial successes served only to excite a temporary illusion; and the occupation of Paris by the allies proved, like its possession by successive parties in the Revolution, decisive of the fate of France.

August 1813.

We are now arrived at the period when, after a contest which, as far as regards England and France, may be termed a war of twenty years, Europe was restored to a condition which promises long continued peace. The principal provisions of the treaty of Paris in 1814, and the Congress of Vienna in 1815, were as follows:

General Pacification of 1814, and Settlement of Europe.

France was circumscribed within her former territory, with the addition of part of Savoy, which, however, was relinquished in 1815 to the King of Sardinia.

Austria recovered Lombardy, and added to it Venice with its adjacent territory; possessing thus a population (29 millions) equal, or very nearly equal, to that of France, and considerably greater than she had had in 1792.

Germany was declared a great federal body as be-

War with France and her Allies.

fore the French Revolution; with the distinction that a number of petty districts and principalities were incorporated into the larger, such as Bavaria, Wirtemberg, Hesse Cassel, Hesse Darmstadt; and with the farther distinction, that there is now no imperial head, but an understood division of influence between the two great powers; Austria being the protectrix of the south, Prussia of the north. These are progressive advances towards consolidation, and to them are to be added the formation of a Diet, still devoid of unity and slow in deliberation, but not altogether so tardy or disunited as its predecessors at Ratisbon.

Russia has, during the present age, suffered no reduction of her territory, but has proceeded in a regular course of acquisition. Her power, though less colossal than is vulgarly supposed, has received a substantial addition by the acquisition of Finland and of the chief part of Poland. Two-thirds of what once was Prussian Poland, and a part of Galicia, were formed in 1815 into a kingdom, the crown of which is worn by the Czar.

Prussia, on the other hand, has exhibited a striking example of the mutability of political greatness. Raised by the talents of Frederick II. to a rank above her real strength, but making, after his death, successive additions to her territory by the dread of her arms, and by diplomatic combinations, she saw the whole overturned by Bonaparte in one fatal campaign. From 1807 to 1813 her dominions continued circumscribed, and her population hardly exceeded six millions. But the arrangements of 1814 restored to her a third of Russian Poland, and a valuable tract of country on the Lower Rhine; and her population is now, as in 1806, above ten millions.

Of her colonial conquests from France, England retained Tobago, St Lucie, and the Isle of France. The peace confirmed also our possession of Malta and the Cape. Of the other Dutch settlements, Surinam and Java were restored; but Demerara, Berbice, and Essequebo, containing a number of British settlers, were retained; the merchants of Holland, however, enjoying certain privileges of trade with these colonies. On the Continent of Europe, we effected an important and long desired measure, the union of the seven Dutch and ten Belgic provinces into one kingdom. The latter, in their detached state, presented too tempting an object for France, and would have proved the cause of repeated wars, in which England, from her interest in the independence of Holland, and her dread of invasion, could hardly fail to participate.

The losses of Denmark rank among the most painful consequences of the wars of the French Revolution. To strip that pacific and inoffensive kingdom, first of its navy and next of a kindred country, governed by the same sovereign during 400 years, were acts that called for the regret and condemnation of every unprejudiced observer. The transfer of Norway was opposed by the inhabitants, and, we add with regret, that our navy was ordered to take part against them by blockading their ports. At last all was terminated by a convention pronouncing the union of Sweden and Norway under the same sovereign, the latter retaining her separate constitu-

[October 20, 1814.]

tion. Pomerania was transferred from Sweden to Prussia, and Denmark received a small territory to the south of Holstein.

Sweden had enjoyed during many years the advantage of neutrality, and, like Denmark, increased gradually her shipping and trade. Deviating from this in 1805, and becoming a party to the coalition against France, she was saved from hostilities by the rapid overthrow of Austria; and Pomerania was not attacked until 1807, when Gustavus IV. chose to refuse peace at the time when he had not the support of a single continental ally. This and other acts of madness led to his deposition in 1809; and the year after Europe saw with surprise the nomination of Bernadotte as the efficient head of the Swedish government. This choice, attributed at first to the interference of Bonaparte, was due (*Memoirs of* Madame de Stael, Vol. III. Chap. iv.) to the personal exertions of Bernadotte himself. The acquisition of Norway, and the introduction into Sweden of various improvements by an active minded foreigner, are advantages of magnitude, and calculated to form some counterpoise to the loss of Finland, and the increased danger from Russia.

Spain and Portugal preserved their territory unaltered; both had received rude shocks from the invader, but in both the reign of superstition and indolence seemed so firmly fixed as to bid defiance to political change, whether introduced by mild or harsh means. The events of 1820, however, have shown, that in Spain there exists that sense of the abusive nature of their institutions, and that desire of reform which in France produced the Revolution; while in Portugal, results, eventually favourable, may be expected from the continued absence of a bigoted court.

Switzerland, without being made a province of France, had been obliged to furnish a military contingent in the wars of Bonaparte. The arrangements of 1814 maintained her as a federal state, but with 19 cantons instead of 13; an increase derived, not from extended territory, but from the independent form acquired by certain districts (such as the Pays de Vaud) incorporated formerly with the original cantons.

The King of Sardinia was restored to Piedmont, and his other continental possessions, with the addition of the territory of Genoa.

Italy was the country of all Europe the most likely to profit by the occupancy of the French. The substitution of an efficient government for the feeble administration of Naples and Rome; the diminution of superstition, the increase of industry, the extirpation of robbery on the high ways, the new modelling of the military establishment, were all objects of the highest importance. To these was added a hope of blending all the states of the Peninsula into a common union,—a union most ardently desired by the Italian nation, and calculated, above all things, to preserve their country from war and the intrusion of foreigners. The selfish policy of Bonaparte, whose object was merely to extract from every country the utmost possible supply of revenue and recruits, prevented the adoption of this grand measure, until the reassumed sway of foreigners, in particular of the

War with the United States.

Austrians, removed it to an indefinite distance, and reinstated the territorial divisions of Italy on the footing of 1792, with the exception of the republics of Venice and Genoa.

The royal family of Naples remained in Sicily during 1814, but Murat was not recognised by the Bourbons, and dreaded, with reason, that the allies would deem their task incomplete, if they did not restore the crown of Naples to the ancient family. He armed in self-defence, and no sooner did he hear of Bonaparte's entrance into Lyons, than he advanced against Lombardy, and called on all Italians to unite in the assertion of their national independence. But his troops were unable to cope with the Austrians; after some partial successes they were obliged to retreat; and finding, in some sharp actions on their own territory, the continued superiority of their opponents, the eventual result was the dispersion of the Neapolitan army, and the surrender of their capital on 22d May. The royal family now returned from Palermo to Naples, and resumed their sovereignty. Murat escaped to Toulon; but, after the second return of the Bourbons, he proceeded to Corsica, and conceived the wild project of landing in the Neapolitan territory, at the head of a feeble detachment, in the hope of being joined, like Bonaparte, on returning from Elba, by thousands of his ancient followers. He disembarked in Calabria, but was forthwith attacked by the inhabitants, taken and shot by order of the royal family, who were thus left in undisturbed possession of the crown.

Mar. 1815.

October 8.

Turkey was no party to the treaty of 1814, but remained on the footing on which the treaty of 1812 with Russia had placed her. Stationary in an age of change, and inflexible in her adherence to traditionary usages, she saw the French Revolution pass without hurt; or rather was indebted to it for a relaxation in the shocks to which the European part of her empire is exposed from Austria and Russia. The peace of 1790 had been preserved uninterrupted by Austria; that of 1791 was infringed by Russia by only one war, viz. from 1807 to 1812. The temporary occupancy of Egypt by the French, and the more permanent establishment of England in the Ionian Islands, have had no effect on the interior of the Turkish empire.

II.—*War with the United States of America.*

Origin of our Differences with America.

We are now obliged to record military operations conducted in a very different quarter, and involving considerations very distinct from those which animated the contest on the continent of Europe. The United States of America continued on friendly terms with us during several years after the beginning of the war of 1803. There existed discussions, and of rather a serious nature, between the two countries, particularly in regard to the practice of our naval officers of impressing American seamen on suspicion, or pretended suspicion, of their being British subjects; but these contests were happily confined to diplomatists. Meantime, the navigation of the Americans was in a course of rapid extension; for their neutral flag enabled them to act as carriers to the continental belligerents, and, in particular, to convey to Europe the produce of the French and Spanish West Indies. The depression of our West India trade in 1805, though the unavoidable result of too great a growth of produce for a system of monopoly, was attributed to the successful rivalship of the Americans in the continental markets. Mr Pitt was assailed by our ship-owners, and prevailed on to take measures which obliged the Americans to forbear the direct passage across the Atlantic, and to give such cargoes a neutral character by carrying them in the first instance, to their own ports. The Grenville ministry maintained what Mr Pitt had done, and went no farther; but they were succeeded by men actuated by different views. A parliamentary committee, appointed in June 1807 to inquire into the distress of our West India colonies, received evidence calculated to strengthen an impression already very general, that a total stop ought to be put to the conveyance of French or Spanish colonial produce in neutral bottoms. No sooner did the successful termination of the Copenhagen expedition give popularity to the "system of vigour," than we issued the *Orders in Council* of November 1807; the object of which, however disguised, was to put a stop to neutral traffic, except when carried on by licence from our government, thus assuming the power of restricting or extending that traffic as we should find beneficial to our interests; or rather, as we should imagine, to be beneficial, since, in questions of commerce, the real is frequently far different from the anticipated result.

War with the United States.

Suspension of Neutral Trade.

In this explanation of these ill-understood Orders, we exclude from the motives of ministers all participation in that jealousy of America that actuated so many of our countrymen. We consider them as acting from conviction, as seeking in this measure only a source of benefit to our commerce, and of annoyance to our enemies in Europe; yet, even with these qualifications, the Orders in Council have contributed more than any other measure in the present age to the distress that now afflicts our country. Their first practical result was a suspension of the navigation of the Americans, by a general embargo imposed by their own government: this preliminary measure was, in a few months, succeeded by a non-intercourse act, which continued in operation above a year, during which our exports to America were greatly reduced, and our manufacturers distressed to a degree that ought to have served as a warning of the consequences of a farther contest with our best customers. In 1809, in consequence of a temporary arrangement, the intercourse was resumed, and exports from England to America took place to a great amount. But the offensive part of our system was soon after revived; the Americans were prevented from trading with France, Italy, or Holland, and the only conciliatory answer given by our government, was a promise to recall our orders whenever the Americans should obtain from Bonaparte the repeal of his Berlin and Milan decrees. This repeal was in some measure obtained in 1810, but nothing could wean our ministry from their predilection for what they account-

Dec. 22, 1807.

ar with United States. ed a grand political measure; and those who inspect the official communications of the two governments,* will see with surprise the expedients devised, and the promises held out to gain time, and to delude the Americans, while, in fact, there never was an intention of recalling the obnoxious decrees. The Americans offered explicitly (*Letter from Mr Monro to Mr Foster*, 26th July 1811) to recal all hostile edicts "if we revoked our orders;" but this not being complied with, their ports were definitively shut against us, and our manufacturers reduced to great distress,—a distress pourtrayed in colours unfortunately too impressive in the parliamentary papers on the *Orders in Council*, printed in the early part of 1812. But no change could be effected in our measures till the accession of Lord Liverpool to the first ministerial station, when a repeal took place, but unhappily too late, the Americans having declared war before this intelligence could reach them. From this time forward the impartial narrator finds it his duty to transfer the charge of aggression from England to America. We had now a minister aware of the evil tendency of our Orders in Council, and prepared to make reasonable concessions to the Americans, while they, heated by the contest, and attributing the change to the dread of losing Canada, refused our offers of accommodation.

ar declared 18th June 1812.

aval Operations. The naval conflicts in the first year of the war were of a nature greatly to surprise the public, accustomed as it was to our almost uninterrupted triumphs at sea. The Guerriere frigate was captured on 19th August (1812) by the Constitution, American frigate, and the Macedonian on 25th October by another American frigate, called the United States. If these losses could, in any degree, be attributed to the fault of our officers, no such charge could be brought in the case of Captain Lambert of the Java, a most intelligent seaman, who, after a dreadful conflict, was obliged, on 29th December, to strike to the Constitution. In this, as in the preceding actions, the real cause of failure lay in the disproportion of strength, the Guerriere having only 263 men, her antagonist 476; the Macedonian only 300, the United States 478. Even the Java, though a large frigate, had only 367 men, her opponent 480. The inequality in weight of metal was still greater, each of these American frigates having been originally intended for a ship of the line. No sooner did the two nations meet on an equal footing in the case of the Chesapeake and Shannon (June 1st 1813), than the superiority was found to rest with us.

Operations in Canada. The operations by land were offensive on the part of the Americans, and directed to the conquest of Canada, of which the frontier adjoins their northern states, extending in a long line from south-west to north-east. The boundary consists in a great measure of water, being formed partly by the great lakes Erie and Ontario, partly by the course of the St Lawrence. On the south-west part of this frontier, a body of 2300 Americans, regulars and militia, advanced in July 1812 from the small fort of Detroit. Their operations, at first successful, were soon checked by a British detachment; retreat became unavoidable, and our troops assuming the offensive in their turn, the result was the surrender (16th August) of the whole body of Americans and of the fort of Detroit. Not discouraged by this failure, another detachment of Americans assembled near Niagara, but, after a sharp action (13th October), were obliged, like their countrymen, to surrender. A farther attempt, on the part of the Americans, to force the Niagara frontier, on 28th November, was likewise unsuccessful; while, in a different quarter, at a distance of nearly 300 miles to the north-east, the advance of their main body to Champlain proved ineffectual, the preparations on our side necessitating their retreat. Lastly, a detachment advancing, in January 1813, in the hope of retaking Fort Detroit, were themselves attacked by a British division and obliged to surrender.

War with the United States.

Campaign of 1813. These repeated failures were the result, not of a deficient activity or courage, but of impatience and insubordination; the restraint of discipline being ill-suited to a nation that acknowledges no master. But, in the next campaign, the Americans took the field with augmented forces, and an improved plan of action. A strong division crossing Lake Ontario, landed on 27th April, at York, the chief town of Upper Canada, and took it, with its stores, and part of the garrison. A check was, indeed, given to them in a very different quarter, on the Miami, a river falling into Lake Erie; but, next month, a strong body of Americans penetrated the Niagara frontier, and an attempt made by the British on Sackett's harbour, a port in Lake Ontario, was not successful. Still the progress of the American main body into Canada from the Niagara was obstructed, and checks experienced by them in a way that clearly demonstrated the inexperience of their troops. They forbore, therefore, to advance by land, and directed their efforts to a naval superiority. On Lake Erie, the more remote of the two from our Canada settlements, this superiority was acquired in September, after the capture of our petty squadron, under Captain Barclay, and the consequence was our abandoning the more distant posts in Upper Canada. On Lake Ontario, the naval contest was long maintained; and an attempt made, in November, by a strong division of Americans, to descend the St Lawrence in small craft, and to threaten Montreal, was rendered abortive by the activity of our troops. The campaign was then closed by our opponents without making any serious impression on Canada, though their force exceeded 20,000 men. On our part, the campaign terminated by taking Fort Niagara by surprise, and by repulsing, near the small town of Buffalo, a corps of 2000 men, brought forward to check our advance. The town was burned, in reta-

April 23. May 27. May 28. June 6 and 24. Dec. 19.

* See the *American State Papers*, printed in 1811 at Philadelphia, and reprinted in London.

War with the United States.

liation for a similar excess committed by the Americans.

Campaign of 1814.

The inclemency of an American winter suspended hostile operations for some months. The first exploit of consequence, in next campaign, took place on Lake Ontario, and was an attack by a British division and squadron on Fort Oswego, which, with its stores, fell into our hands. (May 6.) In the beginning of July, an American division, 5000 strong, crossed the Niagara, already so often traversed, and obliged the opposing force to retreat. But the opportune arrival, from Bourdeaux, of some regiments which had served in France, soon enabled our troops to make a stand; and, on 25th July, there took place an action more obstinate, and better sustained on the part of the Americans, than any in the present war. They were finally repulsed, but the loss was heavy on both sides. (Sept. 17.) Some time after, a sally made by the garrison of Fort Erie against a detachment of British entrenched in the vicinity, though at first successful, was eventually repulsed. But a very different result attended an offensive enterprise, on a large scale, attempted by us on the side of Lake Champlain. For this purpose, our Commander, Sir G. Prevost, assembled all his disposable force, amounting, with the reinforcements from Europe, to nearly 15,000 men, crossed the American frontier, and marched southward to attack Plattsburgh, a fortified town on Lake Champlain. The attack on the land side was combined with that of a flotilla, consisting of a frigate and several small vessels, which, coming within sight on 11th September, engaged an American flotilla of nearly equal force. Unfortunately, our commanding officer was killed, and our flotilla captured,—a check which, though in itself of no great moment, induced our general to make a sudden retreat. This retreat, in the face of so inferior an enemy, was altogether inexplicable, and excited general surprise and disappointment. With it closed the operations on the side of Canada, each party having entirely relinquished the idea of offensive war.

Operations in the Central part of the United States.

So long as there remained a hope of treating with the Americans, our government had avoided offensive operations, and kept the command of our fleet in that station in the hands of Sir John Borlase Warren, an officer who joined diplomatic to nautical habits. At last, however, it became necessary to replace him by one whose spirit of enterprise was more conformable to the impatient ardour of our navy. Admiral Cochrane arrived, and lost no time in concerting an attempt on the American capital, by sailing up the Patuxent, destroying a flotilla in that river, and landing a military force under Major-General Ross, (Aug. 24.) which attacked the American division posted to defend Washington, drove them from their ground, and entered the capital in the evening. Here private property was respected, but of the public buildings there were destroyed not only the arsenal, the dock-yard, the war-office, but the houses of the senate and representative body, the residence of the president, and the bridge across the Potowmac. Our troops, being few in number, retreated soon after, and, embarking anew, proceeded against Baltimore, where they landed, drove the defending force of the Americans from their position, and approached the town. But the entrance to the harbour being closed by a barrier of sunk vessels, co-operation on the part of the navy was impracticable, and our troops were re-embarked without any loss of consequence, except that of their commander General Ross. A better result had been obtained in an expedition against Alexandria, a trading town on the Potowmac, whence a quantity of stores and shipping was brought away. Success also attended an expedition in a very different quarter;—in the river Penobscot, at the northern extremity of the United States, adjoining the British province of New Brunswick. Far different was the result of an expedition on a larger scale, directed against New Orleans.

Attack on New Orleans. Dec. 23.

Our troops disembarked from the Mississippi, repelled an assault from the Americans, moved forward, and came within six miles of the town, where they found the enemy posted behind a canal, with a breast-work in front, and their right flanked by the Mississippi. After a fortnight passed in mutual preparations, a night attack was at last determined on; but, (Jan. 8.) unexpected difficulties retarding it till day-light, the fire of the Americans from behind their breast-work was pointed with unerring aim, and proved extremely destructive. In the short space of twenty minutes, our three principal officers, and nearly 2000 privates, were killed or wounded; and though, on the opposite side of the river, our attack had been successful, it was determined to relinquish the expedition, and re-embark the troops. This distressing failure was poorly compensated by the capture of Fort Mobile, (Feb. 11.) the last land operation of the war. At sea, our final exploit was the capture of the American frigate President, of 54 guns, and 490 men.

Peace.

The peace was signed at Ghent, on 24th December 1814, and its terms afforded a curious exemplification of the futility of warlike struggles. The territorial possessions of both countries were, with a very trifling exception, left on the same footing as before the war; and not the slightest notice was taken of the questions which had most strongly excited the spirit of hostility on both sides;—neither of the impressment of seamen, a point so important to the Americans, nor of the limitation of the rights of neutral traffic, a topic so often urged among us.

Ruinous Effects of this War.

The United States, in no respect a manufacturing country, purchased from us merchandise to an extent annually increasing, and which, in 1807, had reached the amount (see our article ENGLAND, p. 134) of L. 12,000,000 Sterling. Every addition to their capital, every year that they passed in peace and prosperity, increased their value to us in a commercial sense, while every blow given to their productive funds necessarily operated in diminution of their purchases and payments. But, far from acting on these impressions, the ministry of 1807 eagerly seized the opening given them by the violence of Bonaparte, to assail the trade of America; and issued (in November) those Orders which "prohibited all direct intercourse from a neutral port to France, or her tributary states, unless the neutral vessels, intended for such voyages, touched first at a port in the British dominions, and paid a duty." This singular measure was vindicated, not as legal in itself, but as a trespass on neutral rights justified by the

Return of Bonaparte.

previous trespasses of the French government. It would, it was argued, distress the part of the Continent subject to Bonaparte, and excite discontent against his government; but the real motive was to cramp and control the trade of neutrals. That the Americans would not submit to such humiliating conditions, our Government was well aware; but it knew also that they had neither army nor navy, and would not, at least for several years, resort to the alternative of war. So far our calculation was correct, but the question of national advantage we entirely misconceived. For what was the practical operation of these restrictive edicts? The trade of the Americans with the Continent was suspended, and the remittances formerly made to us from the sale of their goods,—remittances not overrated (Baring *on the Orders in Council*) at four or five millions a year, were made no more. Our bank paper fell, more from that than from any other cause, into a discredit which occasioned a loss of 20, 30, and eventually nearly 40 *per cent.* on all subsidies and other government expenditure on the Continent. The mercantile insolvencies in America, which followed the Orders in Council, recoiled, in a great degree, on England, whose exporting merchants were the chief creditors of the bankrupts. Next came the burdens and the havoc of war; and of every million of American capital thus diverted from productive industry, the half at least was lost to the British manufacturer. But this was not all; the suspended intercourse, and the appeal to arms, induced the Americans to attempt to manufacture for themselves. This, for several years, excluded our goods, and when, on the return of peace, British merchandise was poured into the United States at prices so low as to defy competition, the consequence, particularly in the year 1819, was a scene of general insolvency in the States, which once more recoiled with the most distressing effects on the British creditor. All this was the result of a policy, bad in every point of view, and which neither had nor could have any decisive influence on the grand contest in Europe.

III.—*Return of Bonaparte, and Events of* 1815.

The ratification of the peace with America had not been received from the other shore of the Atlantic, when the return of Bonaparte from Elba raised in Europe a fresh alarm of war. He ventured to land with a force barely sufficient to secure his personal safety in a march, and to supply emissaries for mixing with the opposite ranks. The French soldiers are fond of glory; and their attachment revived at the sight of their leader. They first refused to oppose, and soon after pressed forward to join him; and he proceeded in a rapid and unresisted march to the capital. Ought England to participate in the coalition formed to expel this intruder, and to reinstate the Bourbons? On this question there existed, either in parliament or the public, very little difference of opinion, so great was the enmity inspired by Bonaparte, and such the dread of incessant war under his sway. Our ministry soon took their determination; our Continental allies were unanimous in the cause, and not a day was lost in preparing for the invasion of France. The Netherlands, it was evident, would be the first scene of operations; thither the Prussians pressed with all the ardour inspired by recent wrongs; thither were conveyed from England, troops, ammunition, and stores, with all the dispatch afforded by the undisputed command of the sea. By the end of May or beginning of June, the Prussian and British force in the Netherlands was superior to any that could be mustered by Bonaparte. It was not till the second week of June that his disposable force, to the number of 115,000 men, was collected in front of the allied line. This was effected with great secrecy and dispatch. He joined the camp on the 14th, and made his troops march early on the 15th, driving in successively the Prussian outposts at Charleroi and Fleurus. From the beginning of his march to Ligny, the Prussian head-quarters, the distance was thirty miles; to Brussels, the head-quarters of Lord Wellington, was nearly twice as far; and all Bonaparte's hope rested on fighting his opponents separate and unsupported. Intelligence of the first movements of the French reached Lord Wellington in the afternoon of the 15th, and made him forthwith prepare for the march, which, however, he delayed until the arrival of a second courier from the Prussians, and of advices from his own outposts, which should show whether there was any serious attack on other points. In the evening arrived accounts, which left no doubt that the mass of the French army was directed against the Prussians; and orders to march were issued that night in all directions, so as to reach even remote stations between three and four in the morning. Our troops began their march from almost every point at day-light, all pointing to *Quatre Bras*, a spot where four roads meet, and distant seven miles from Ligny. After marching between six and seven hours, several of the divisions stopped to take rest and refreshment; but they were hurried from their unfinished meal by dragoons dispatched to quicken their advance, for Lord Wellington had received by the way intelligence of the rapid approach of the French. Proceeding promptly with his escort, he had time to reach the head-quarters of the Prussians, and to learn from their impatient commander, that, without knowing the numbers of the French, or their plan of attack, he was determined to accept battle on that day, and on the ground he then occupied. Lord Wellington had no controlling power. All he could do was to lessen the pressure on his allies, by pushing, as much as possible, such part of the French as might be opposed to the British. This interview took place between one and two o'clock; and his lordship, returning forthwith to Quatre Bras, found the French *tirailleurs* already in possession of the wood, which skirted and commanded the road. Immediate orders were given to drive them out, a task which devolved on the Highlanders arriving from Brussels, and the Guards from Enghein, each after a march of twenty-five miles. They succeeded in expelling the French; but the want of artillery and cavalry (neither of which came up till late at night) prevented them from pushing forward with effect. Fresh bodies of the French were now seen advancing; and, on the other hand, regiments of British succes-

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Battle of Quatre Bras.

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sively reached the ground. The conflict spread, and was maintained with great gallantry on both sides, but with hardly any other plan than that of fighting straight forward. At first the French possessed considerable advantages, and their cavalry, charging rapidly through fields of rye, which grows in Flanders to a great height, came unexpectedly on some of our battalions; the latter suffered greatly, but fairly repelled their antagonists. As our reinforcements came up, the superiority was progressively acquired by us. The French were driven back, and Ney, who commanded, sent to order up a body of 20,000 men, which had arrived within three miles of Quatre Bras; but the answer was, that they had marched to Ligny by order of Bonaparte. They were soon after ordered back, but were unable to join Ney, until nine at night, when the fighting was over, and the field of action in possession of the British. The force engaged on either side did not exceed 25,000 men. Our loss amounted to 5000; that of the French (see Soult's *Report*) appears to have been considerably greater. Both sides fully expected a new battle the next morning. The British, by the arrival of all their divisions, formed a large army. The French, still strangers to the firmness of our troops, attributed their failure to accidental causes, and declared that their cavalry had been repulsed, *parce quils n'avaient pas franchement abordé l'ennemi.*

Battle of Ligny.

Meanwhile, there had been fought at Ligny a battle on a larger scale, and with greater preparation. On the slope of a rising ground, which, however, was much exposed, a Prussian army, of no less than 80,000 men, awaited the attack of Bonaparte. The fighting began between two and three o'clock, by the French gaining possession of the village of St Amand on the Prussian right. To re-occupy this village, Blucher made repeated efforts; and it was during one of the most furious of these, that Bonaparte is understood to have ordered round the corps, the absence of which was so bitterly regretted by Ney. The battle now raged along the whole line. The masses of Prussian infantry, drawn up on the slope, were much thinned by the French artillery; but in the village of Ligny, which was repeatedly taken and retaken, the slaughter was mutually great. Such was the course of the engagement till the evening at half past eight o'clock, when the French reserve, marching forward in columns, obliged the Prussians to leave the long-contested field. Their loss on this dreadful day was not short of 20,000; that of the French 10,000.

Next day Bonaparte adopted the plan of detaching, under Grouchy, a body of 34,000 men to follow the retiring Prussians, while, with the mass of his force (71,000), he turned against the British, in the hope of fighting a battle at the head of superior numbers. Lord Wellington knew not till morning the retreat of his allies; a similar measure, on his part, then became indispensable; but as his army was in the best state, and as the Prussians had just received a reinforcement, retreat was necessary only until reaching a position favourable for fighting, and for awaiting the co-operation of his allies. Waterloo, he well knew, presented these advantages; his march thither met with no annoyance from the French, and the only fighting that took place on the 17th was at Genappe, in a cavalry action begun by our rear-guard. Bonaparte, following with his van, reached the ground opposite to our position, and, in the evening, ordered a partial cannonade, to ascertain if we occupied the latter with an intention to remain. He concluded in the affirmative, and began arrangements for a battle; next morning, he continued under a similar impression, although in his army there was (see Drouet's *Account of the Battle*) a general belief that we would not venture to assail their onset. At ten o'clock, he perceived, by his glass, a corps in march at a great distance, which he immediately concluded to be Prussians; this necessitated his posting a body of above 8000 men on his right to receive them,—a disposition which deprived him of his numerical superiority, and made the battle of Waterloo be fought between equal, or nearly equal forces. It began, towards noon, by an attack on the post of Hougoumont, *a chateau*, or country seat, in front of our right, surrounded by an orchard: the possession of this point would have favoured the approach of the French to our right wing, but though they drove us from the orchard, all their efforts proved ineffectual against our troops (a detachment of guards) stationed in the building and within the court wall. This attack, though very obstinate and sanguinary, was, in the eye of either commander, only a prelude to the great onset in the centre. That began towards two o'clock, planned by Bonaparte, and conducted by Ney, whose station, during the action, was in the high road leading straight to our centre. Our army made little show, the battalions being formed in squares, and partly hid from view by the sinuosities of the ground: between each square were openings sufficient to enable the battalions to deploy into line, as well as to afford our cavalry space to advance and charge. The squares were farther placed *en echiquier* (like a chess-board), so that the enemy's cavalry, in venturing through an opening, exposed itself to a fire in front from the opposite square, and to a flank fire from that which it had passed. Yet this firm array did not appal the French Cuirassiers, who, confiding in past success and in the protection of their armour, repeatedly tried the deadly experiment of attack. Never was the impetuosity of the French more conspicuous, and never was it more effectually opposed, whether we consider the firmness of our troops, the judgment of our general, or the efficiency of our artillery. The only ground gained by the French, was the central point of La Haye Sainte, and the space immediately in front of our line,—the whole attended, said Ney, " by a carnage the most dreadful I had ever seen." Meanwhile Bonaparte watched anxiously the moment when a partial breach, or disorder, in our line should afford him a favourable opportunity of attacking with his reserve. Ney repeatedly intimated an expectation of great success, but could report no positive advantage, even after the double charge made by the Imperial Horse Guards at five in the afternoon. It became, however, indispensable to act, and Bonaparte could hardly doubt that the long continued conflict must, by this time, have greatly weakened our line. Accord-

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ingly, between six and seven o'clock, the Imperial Foot Guards, to the number of nearly 13,000, were drawn from behind the ridge which had hitherto covered them from our fire; directed to advance along the high road leading to our centre; and harangued by Bonaparte, whom they answered with reiterated cries of *Vive l'Empereur*. We are now come to the decisive part of the battle, that part in which till now, whether at Marengo, at Austerlitz, or at Ligny, success had uniformly attended the charge of a fresh and numerous corps. By what means did it fail at Waterloo? The answer is, that our line, though thinned, was nowhere disordered; our battalions, though reduced, were firm in their position. Besides, the Duke, apprised of the approach of his allies, moved round an additional force from his left to his centre, and directed our battalions to deploy from their squares into line;—a line not of two ranks, but of four. Its formidable aspect, and the knowledge of the approach of the Prussians, prevented Ney from attempting the last alternative, a bayonet charge by the Guards. Their ranks, however, were rapidly thinned, for the fire from our line was much more extensive and destructive than that of the columns of the enemy. It was now that the Duke saw the approach of the Prussian main body, and ordered a general movement forward; the French retired, at first slowly and in good order; but seeing that behind them all was falling into confusion, the artillerymen and waggon train, cutting the traces of their horses, and pressing to gain the high road to which the Prussians were fast advancing, the retreat became a rout. Our troops advanced over the field of battle, crossed the hollow beyond it, and, towards nine at night, reached the ridge occupied by the French Staff during the day. Their task was now fulfilled, and the Prussians were left to follow the flying enemy. The loss on our side was 13,000 men; that of the French opposed to us, exclusive of the loss caused by the Prussians, was about 20,000.

This great battle displayed no manœuvring; the plan once formed, the whole was a succession of impetuous attacks and obstinate repulses; but the talents of either commander were not the less displayed, the one in making no fruitless application of his force; the other in never permitting the ardour of his troops to lead them from their ground or to deviate from a defensive plan. Bonaparte committed only one error,—that of ordering the advance of his guards, who, though they might penetrate our line at a particular point, had no chance of gaining a victory, and were besides likely to be soon wanted as a rear-guard to their own army. In the battle, Lord Wellington appears to have committed no error; on the preceding days, his fault lay in supposing Blucher likely to act with discretion, and in remaining personally at Brussels, instead of keeping near to his impatient coadjutor. Had the latter avoided fighting on the 16th, and retreated only twelve or fifteen miles, the allied forces would have been completely in co-operation, and their numbers (160,000) would have deprived Bonaparte of every chance.

From Waterloo to Paris, the advance of the allies was an almost uninterrupted march; marked on our part by the capture, by escalade, of two towns, Cambray and Peronne; on that of the Prussians by an unremitting pursuit of the enemy. On one occasion (2d July, near Versailles), a corps of French cavalry reasserted their claim to fame, and taught the Prussians the hazard of a precipitate advance; but the success was partial, the evacuation of Paris unavoidable, and resistance hopeless; now that almost all Europe was pouring her armies into the French territory. Hence the second treaty of Paris (see the Article FRANCE), concluded after many vain appeals to the generosity of the allies, and which burdened France with contributions to the amount of nearly L. 30,000,000 Sterling, exclusive of the support of an allied army on her frontier. This army, amounting at first to 150,000 men, was reduced in 1817 to 120,000, and withdrawn in the end of 1818; since which all has borne the aspect of tranquillity on the Continent.

Nov. 20, 1815.

Reflections on the War.

The time is not yet arrived for viewing, with the calm impartiality of history, our war against Bonaparte; but the more reflecting part of our countrymen can hardly fail to regret our participating in the war of 1792. Those who know the inoffensive state of the French nation at that time, their general wish for peace, and the reduced condition of their army, can have no doubt that the efforts which subsequently poured forth such a host of combatants, owed their existence to the threats of the allied powers; without these the Jacobins would not have triumphed, nor would a military adventurer, like Bonaparte, have had the means of acquiring an ascendancy. Louis XVI. might have been brought to the scaffold, and republican visions have prevailed for a season, but the eyes of the people would have been opened to the blessings of a constitutional monarchy much earlier than when threatened with invasion, and obliged, in self-defence, to throw undue power into the hands of their new rulers. The first great error,—the coalition of 1792,—was the act of Austria and Prussia; but of the continuance of the Continental war, after 1795, we were almost the sole cause. Belgium and Holland had, it is true, fallen into the hands of France, and to recover them was an object of the highest interest; but in attempting this, our ministers made no adequate allowance for the jealousies, the prejudices, we may add, the incapacity of the governments whose aid was indispensable to success. In 1803, circumstances had become extremely embarrassing; France was confirmed in the possession of the Netherlands and Italy, and at the disposal of an ambitious despot, who studied in peace only the means of farther encroachment. What course was our Government to follow? Were they to continue in peace, and to trust for our eventual safety to the progressive extension of our resources and the improvement of our army; or were they to resort to immediate war, and present, by our declared hostility, a rallying point to other powers? An experienced government would have preferred the former; the ministry of 1803 adopted the latter; not from views of ambition, but from yielding to that popular impulse, which it would not, however, have been impracticable to guide and control. As to the course of the war,

Parliamentary Proceedings. it was, during the two first years, a contest without decided success on either side. In its third year, an ill conducted coalition gave to France that superiority which was to be expected in the case of a great military power directed by a single head. Such, in a farther degree, was the result of the continental operations of 1806 and 1807. In 1808, Spain gave an unexpected change to the calculations of politicians, and showed, in an encouraging light, the power of popular resistance; still its effects, aided even by our military means, produced little decisive of the grand objects of the war. We were proceeding with great zeal and gallantry, but without any definite hope or object, when, a catastrophe, as little expected by ourselves as by the French, entirely changed the aspect of affairs, and made it incumbent on us to omit no exertion, financial or military, to redeem the independence of Europe. The success was complete; but it was not till the close of the struggle that we became aware of the amount of the sacrifices incurred in its prosecution.

IV.—*Parliamentary Proceedings since* 1803.

Session of Summer 1803. The parliamentary proceedings in the summer session of 1803 were remarkable as indicating the existence of three or four distinct parties, amidst an almost general concurrence in support of the war. These parties were, *first*, that of the Ministry and their usual followers; *next*, that of the Grenvilles and Mr Windham, who had all along blamed the peace of Amiens, and predicted that it would prove a mere truce; *thirdly*, that of Mr Pitt and Lord Melville, who, after approving that peace, had, on the continued aggressions of Bonaparte, become ardent supporters of war; and, *fourthly*, that of Mr Fox, with a part of the old Opposition, who were of opinion that the war might have been avoided. So far were the last from being numerous, that a motion, made on 23d May, to express the concurrence of Parliament in the war, found a minority of only ten in the Peers and sixty-seven in the Commons. A subsequent measure, in the same spirit, an act for arming a large part of the population, was carried in July by a great majority; and similar ardour was evinced in submitting anew to war taxes, particularly to a 5 *per cent.* Income-tax. After the adoption of several other measures of the kind, and a most interesting session of nine months, Parliament was prorogued on 12th August.

Session of 1803-4. The next session opened on 22d November, and discovered the same alacrity for the prosecution of the war, mixed, however, with a growing opposition to ministers. Mr Pitt had, from the beginning of the war, forebore to commend them, and, since the failure of a negotiation to bring him into office, had assumed a language occasionally hostile. He continued to support their propositions for the public defence, and frequently improved them in their progress through Parliament; but he disclaimed all personal connection with ministers, and at last treated them as incapable of originating any measure of vigour or utility. This disposition could hardly fail to be turned to account by those busy intermediaries, who find means to combine the efforts even of opposite parties for the purpose of getting into power. On 15th March Mr Pitt, aware of the side on which the public was most alive to alarm, brought forward a motion for an "Inquiry into the management of the Navy." On this occasion, severe as was his language in regard to Lord St Vincent, then at the head of the Admiralty, he received the support of the Opposition, and had on his side 130 votes against 201. From this time forward the strength of Ministers was visibly shaken. On 23d April Mr Fox brought forward an eagerly expected motion on the defence of the country, in which Mr Pitt joined, with great animosity against the Ministers. The division was 204 against, and 256 in favour of Government; a majority of 52, which, in a second debate, on 25th April, was reduced to 37. Soon after this ministers resigned, and Mr Pitt, called to the royal presence, was desired to form an administration, with the exclusion, however, of Mr Fox. This peremptory order, and Mr Pitt's too ready acquiescence in it, proved the source of the greatest difficulties. The Grenvilles had recently so connected themselves with Mr Fox and his friends, that a separation would have been altogether dishonourable; and their united strength, joined to the occasional support of Mr Addington's adherents, was the cause, during the remainder of the session, of very strong divisions against the new ministers, particularly in the Commons. Their chief measure, entitled the Additional Force Bill, was carried by only 265 to 223. The session soon after closed, but not without passing a corn bill, evidently intended to dispose the landed interest to submit to the new taxes, and which prohibited the importation of foreign wheat whenever our own should be at or below 63s. the quarter.

Parliamentary Proceedings. 1804. 12th May Change of Ministry.

Before the opening of next session, an overture, suggested, it is said, by the Sovereign personally, was made to Mr Addington. After some discussion it was accepted, Mr Addington receiving the Presidency of the Council for himself, and corresponding situations for his friends. With this support ministers met Parliament; and, in one of the first great questions, the approval of the war with Spain, obtained the concurrence of 313 votes against 106. In subsequent divisions, the majorities, though less decisive, were considerable, until 6th April, when Mr Whitbread brought forward a most interesting discussion on the *Tenth Report of the Commissioners of Naval Inquiry*, which implicated Lord Melville. This question, debated in a full house, produced a division of 216 against 216, when, after an anxious pause, the resolutions moved by Mr Whitbread were carried by the casting vote of the Speaker. This led immediately to the resignation, by Lord Melville, of his office of first Lord of the Admiralty, and was followed by his erasure from the list of privy councillors. Some time after, his Lordship was, at his own desire, heard before the House of Commons, and, while he acknowledged that temporary irregularities in the appropriation of the public money had taken place when he was Treasurer of the Navy, he disclaimed, on his honour, the alleged participation in the profits of Mr Trotter, who had acted

15th Jan 1805. Proceedings against Lord Melville. 6th May. 11th June.

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as his paymaster. But the expectations of the public were raised, and a prosecution, in some shape or other, was indispensable. A motion for an impeachment before the Lords, made by Mr Whitbread, was lost by 272 to 195; but the Addington party joining Opposition in a motion for a criminal prosecution, the latter was carried by 238 against 229. Lord Melville and his friends, dreading this more than an impeachment, found means, by a sudden division of the House, to rescind the vote to that effect, and to decide on an impeachment before the Lords.

1.

25.

Among the remaining acts of the session was one of very doubtful equity—the grant of an annuity of L.3000 to the Duke of Athol, for his long relinquished claims on the Isle of Man. Parliament was prorogued after giving ministers a vote of credit to the extent of three millions, to be applied, if necessary, in subsidies to Continental powers.

2.

The proceedings against Lord Melville made a deep impression on Mr Pitt, and deprived him of his only efficient coadjutor, at a time when, from the magnitude of his public cares, he was more than ever in want of support. The consequent fatigue and anxiety made severe inroads on a constitution naturally not strong. His indisposition became apparent in the early part of winter; and, on the meeting of Parliament, was understood to have reached a dangerous height. His death took place on 23d January 1806. A motion, brought forward a few days after, to grant a public funeral, and to erect a monument to "the late excellent minister," excited much discussion. Mr Fox paid a high tribute to the financial merits of his great rival, but could not join in ascribing the epithet of "excellent" to measures which he had so often opposed. Mr Windham also opposed the vote; and the Grenvilles chose to be absent. Still the motion was carried, by 258 against 169. To a subsequent proposition, for a grant of L.40,000 for the payment of Mr Pitt's debts, no opposition was made.

h of Pitt.

3.

The public attention was now fixed on the approaching change of ministry. The king (in concurrence, it is said, with the death-bed recommendation of Mr Pitt) sent for Lord Grenville, desired him to form a ministry, and made no opposition to the admission of Mr Fox into the cabinet; but is said to have expressed a desire that the Duke of York should retain the office of Commander-in-chief. The new administration was formed on a broad basis, comprising the friends of Lord Grenville, those of Mr Fox, and those of Lord Sidmouth. But, hardly had they entered on office, when circumstances occurred which placed, in a striking light, the different conduct of men when in and out of power. Lord Grenville thought fit to hold the incompatible offices of First Lord and Auditor of the Treasury; and the Chief-Justice was admitted to a seat in the Cabinet; while Mr Fox consented to come forward as the vindicator of both.

26.

New istry.

The defence of the country against the great military power of France being still the most anxious consideration, the first measure of a comprehensive nature was brought forward by Mr Windham, whose station, in the new ministry, was the war department. It proposed the repeal of Mr Pitt's Additional Force Bill, and a plan for improving the regular army, by substituting a limited for an unlimited term of service, and by granting a small increase of pay after the expiration of the prescribed term. These propositions, brought forward in the end of April, and beginning of May, were warmly opposed; they passed, however, by a great majority in both Houses; and would, doubtless, have conduced materially to the improvement of our army, had they received a fair trial; but the succeeding ministries sought, during the whole war, to procure enlistments for life. In France, since 1817, the rule is, to be scrupulous about the character of recruits; to give little or no bounty, but to limit the time of service, and to increase the pay after the expiration of the specified term. The same principle, differently modified, prevails in Prussia and Austria.

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Of the budget, the most remarkable feature was an increase of the property-tax, from $6\frac{1}{2}$ to 10 *per cent.*, the odium of which ministers sought to lessen by the appointment of a Board of Auditors, to examine the long-standing arrears in public accounts. In regard to trade, the principles of this ministry, though little understood, and even disliked by the great majority of merchants, were entitled to much attention. They attempted to introduce into our practical policy some of the doctrines of Dr Smith; doctrines which Mr Pitt had studied in his early years, but to which circumstances had not allowed him to give an extensive application. The letter of our navigation laws forbids all intercourse between our colonies and other countries; but our West India colonies are, in time of war, so dependent on the United States for provisions, that it had been customary with the island governors to take on themselves the responsibility of infringing these acts, and to obtain regularly a bill of indemnity from Parliament. Mr Fox now brought in a bill termed "the American Intercourse Act," the purport of which was, to authorize the governors of our colonies to do, during the remainder of the war, that which they had hitherto done from year to year, and to dispense with any application for indemnity. This bill, moderate and politic as it in fact was, met with keen opposition in Parliament, and with still keener out of doors, from the shipping and commercial interests. It passed into a law; but it was denounced as a glaring infraction of our navigation code, and contributed, more than any other measure, to shake the popularity of ministers.

Trial of Lord Melville.

The trial of Lord Melville before the House of Peers began on 29th April 1806. The charges against him, little understood by the public at large, related to an infraction of his official duty, not as a member of the cabinet, but in his early and inferior station of Treasurer of the Navy. These charges may be comprised under the following heads: That he had allowed Mr Trotter, his paymaster, to take the temporary use and profit of sums of money lodged in the Bank for the naval expenditure; that he had himself participated in such profits; and, finally, that he had applied certain sums of public money to his private use. All participation in the speculations or profit of his paymaster his lordship positively denied, but he acknowledged a temporary appropriation of the sum

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of L. 10,000 in a way which "private honour and public duty forbade him to reveal." The trial closed on 12th June; the articles of impeachment had been extended to the number of ten, and on all of them there was a majority of Peers for his acquittal; but while in regard to the charge of conniving at stock speculations by Trotter, or converting the public money to his private use, the majorities were triumphant, the case was otherwise in regard to his Lordship's permitting an unauthorized appropriation of the public money by Trotter, and receiving from him temporary loans, the records of which were afterwards destroyed.

New Parliament.

Though the present Parliament had completed only four sessions, ministers determined on a dissolution, doubtless from a wish to have the benefit of the government influence in the new elections. They knew their weakness at Court, and flattered themselves that a decided ascendancy in Parliament would enable them to press, with greater confidence, measures for which they could not boast the cordial concurrence of their royal master. For the time of the new election, they chose the moment of national excitement, caused by the recal of our ambassador from the French capital. The first debate in the new House of Commons related to the abortive negotiation for peace, and although the publication of the official papers excited some surprise, and showed that Bonaparte had at one time carried his offers of concession considerably farther than the public had supposed, there prevailed so general a distrust towards him, that Mr Whitbread stood almost alone in the opinion that the negotiation ought to have been continued. After some renewed discussions on Mr Windham's military measures, Lord Henry Petty, then Chancellor of the Exchequer, brought forward a plan of finance, which, assuming the expence of the current year as equal to that of subsequent years of war, professed to provide, without new taxes, for a contest of fourteen years or more. This plan contained an anticipated calculation of the loans necessary for several years to come, and supposed that a sum equal to 10 *per cent.* on each loan should be appropriated from the war taxes, of which 5 *per cent.* should serve to pay the interest of the loan, and the other 5 *per cent.* form a sinking fund, which, by the operation of compound interest, would redeem the capital in fourteen years; leaving the whole 10 *per cent.* again applicable to the same purpose, should the war continue. That this plan possessed, no more than those of Pitt or Vansittart, the merit of increasing the productive power of our revenue, has been already shown by Dr Hamilton in his well known *Treatise on the National Debt.* Its merit, had it been tried, would have been found to consist, as that of such plans generally does, in a support, perhaps a temporary increase, of public credit. It may even be questioned, whether the same ministry, had they continued in office, would have restricted themselves to a limited expenditure in 1808, when the Spanish struggle called forth such a burst of our national enthusiasm. There can, however, be no doubt, that they would have avoided the Orders in Council, which, by depriving us of the unseen but powerful aid of neutral traffic, gave the first great blow to our Bank paper, and consequently to our public funds.

October.

Jan. 29, 1807. Lord Henry Petty's Plan of Finance.

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Abolition of the Slave Trade. Feb. 1807.

The bill for the abolition of the slave trade was now brought forward with all the weight of government support, and carried by triumphant majorities in the Lords by 100 to 36, in the Commons by 283 to 16. This prompt termination of a struggle of twenty years showed how easily the measure might have been carried had not Mr Pitt declined to give it ministerial support; a course, suggested to him, probably by a dread of offending the West India planters, but founded, in a great measure, on misapprehension, since the most respectable part of that body (the proprietors of long settled estates) were far from adverse to the abolition, calculated as it was to prevent that superabundance of produce which to them is the most serious of evils. This proved the last important bill of the Grenville ministry, whose removal from office took place very unexpectedly in consequence of a difference with the sovereign about the Irish Catholics.

Irish Catholic Bill. March 12.

The bill which produced this sudden change was introduced by Lord Howick on 5th March, and entitled, "A bill to enable his Majesty to avail himself of the services of all his liege subjects in his naval and military forces, in the manner therein mentioned;" that is, by their taking an oath contained in the bill, after which they should be left to the free exercise of their religion. Here, as in the case of the American intercourse with the West Indies, the intention was less to introduce a new practice, than to permit by law what was already permitted by connivance. The draught of the bill had been previously submitted to the King, and returned by him without objection; but the royal attention was more closely drawn to it on its introduction into parliament, and on a vehement opposition from Mr Perceval, who described it as part of a system of dangerous innovation, and as a precursor of the abolition of all religious tests. The king now intimated his disapprobation of the bill to ministers, who endeavoured to modify it, but still without succeeding in rendering it acceptable to their sovereign. They then felt the necessity of withdrawing the bill, but inserted in the cabinet minutes a declaration, reserving to themselves two points—the liberty of delivering their opinion in Parliament in favour of the proposed measure, and of bringing it forward at a future period. This minute was unfortunately couched in terms too positive, if not disrespectful to the King, who, always tenacious on the Catholic question, and never personally cordial with Lords Grenville and Howick, insisted that they should pledge themselves in writing never to press him again on the subject. Ministers declining to comply, the King consulted with Lord Eldon about forming a new ministry, and, receiving a ready assurance of the practicability of such a measure, refused to listen to a modified acquiescence with his late order, offered rather tardily by Lord Grenville. Ministers gave up the seals of office on 25th March; and, next day, the change and the causes that led to it were fully discussed in Parliament. A short adjournment now took place, after which there occurred some remarkable trials of strength between the two parties. An independent

March 12.

member (Mr Brand), with reference to the conditions on which the ministry had come into office, made a motion that it was contrary to the duty of members of the cabinet to restrain themselves by a pledge from advising the King on any subject. This motion produced a very long debate, but was lost by 258 against 226; while a corresponding motion in the Lords was lost by 171 to 90. A subsequent proposition, to express the regret of the House at the removal from office of so firm and stable an administration, was lost by 244 against 198; and it became apparent that in Parliament, as at Court, the fall of the Grenville ministry was decided.

It remains to make a few observations on their conduct when in office; and here an impartial inquirer will not be long in discovering that both their merits and demerits have been greatly exaggerated. Their war measures proved unimportant, particularly in the point which, in the then ardent state of the public mind, superseded all others—the annoyance of France; and the result was, an unconsciousness in the greater part of the people of what was really valuable in their views and conduct. Yet Mr Fox brought to the department of foreign affairs an intimate knowledge of continental politics, and an exemption from national prejudices, far, however, from being accompanied, as the vulgar supposed, by an indifference to our national interests. Lord Grenville, if naturally less conciliating, and less fitted for grand views, possessed a practical knowledge of business, and had become aware in retirement of the various errors arising from a too early introduction into office. They had a liberal feeling towards Ireland and the United States; and though by no means lukewarm in their resistance to Bonaparte, they all held the impracticability of making any impression on his power by force of arms, until the occurrence of some combination of circumstances which should justify a grand and united effort. In what manner they would have acted had they been in power when the general insurrection in Spain burst forth, the public have no means of judging; so different is the language and even the feeling of politicians when in and out of office. Several of their measures, such as the introduction of the Lord Chief Justice to a seat in the cabinet, and the assent to the appointment of such a commander as Whitelocke, were singularly ill-judged. To place Lord Grey, and after him Mr T. Grenville, at the head of the Admiralty, was to declare to the public that professional knowledge was unnecessary in that high station, as if its effects had not been most beneficially displayed in the administration, short as it was, of Lord Barham. Finally, their intemperate declaration in the Cabinet minute of 12th March, evinced a strange miscalculation of their strength when put in opposition to the personal will of the sovereign and the existing prejudices of the public. The result was, that their fall caused no regret to the majority of the nation, and that the errors of their successors excited no wish for their recall.

Of the new ministry the efficient members were Mr Perceval, Chancellor of the Exchequer; Mr Canning, Minister for Foreign Affairs; Lord Castlereagh for the War, and Lord Liverpool for the Home Department. One of their first measures was a prorogation of Parliament, followed by a dissolution, which gave them, in the elections, the advantage so lately enjoyed by their predecessors, with the farther advantage of an alarm strangely excited in the public mind on the ground of Popery. The new Parliament met on 22d June, and, after passing the bills requisite for the army, navy, and other current business, was prorogued on 14th August.

The Session of 1808 was opened on 31st January by a speech of uncommon length, which enlarged on the Copenhagen expedition; our relations with Russia, Austria, and Sweden; the departure of the royal family of Portugal to Brazil, and our Orders in Council respecting Neutrals. The chief debates of the session related to these subjects. The Copenhagen expedition was much canvassed, as unprovoked by Denmark, and incompatible with the honour of England. Still that measure received the support of a great majority, Mr Ponsonby's motion for the production of papers relating to it being negatived by 252 to 108, and a similar motion in the House of Lords by 105 to 48. Even a motion for preserving the Danish fleet, to be restored, after the war, to Denmark, was negatived in both Houses.

The volunteer system had, since 1804, been greatly relaxed, and the country evidently stood in need of a more constant and efficient force. The Grenville ministry, adverse to the Volunteer System, had determined to let it fall into disuse, and to replace it by a levy of 200,000 men, to be trained to act not in battalions but separately, and as irregulars, on the principle that local knowledge was the chief recommendation, and a continuance of previous habits the proper exercise of such a force. The new ministry, however, pursued a different course, and passed an act for a local militia; a body which, with the exception of the officers, was composed of the lower orders, pledged to regular training during one month in the year, and subjected to all the strictness of military discipline. Such of the volunteers as chose were to remain embodied; the total of the local militia was about 200,000, and the mode of levy was by a ballot of all persons, not specially exempted, between the age of 18 and 31.

The Orders in Council were frequently discussed during this session, but they were as yet imperfectly understood either in their immediate operation or in their consequences. Unfortunately for the advocates of moderation, Bonaparte now lost all regard to justice, and committed the most lawless of all his acts—the seizure of the Spanish crown. Indignation at this atrocity, and a firm determination to support the Spanish cause, were manifested by men of all parties, among whom were remarkable, as habitual members of Opposition, the Duke of Norfolk and Mr Sheridan; the latter making, on this occasion, one of the most brilliant speeches of his latter years.

The Session of 1809 was opened on 13th January by a speech declaring a decided determination to adhere to the cause of the Spaniards, notwithstanding the failure of the campaign, and the retreat of our army, under Sir John Moore. The intelligence that arrived soon after the death of that commander, drew from the house a unanimous eulogy of his character,

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and regret for his fall. There still prevailed, both in Parliament and the public, a strong attachment to the Spanish cause; and, in the various motions made by the Opposition to censure ministers for mismanaging our armaments, or ill-planning our operations, the minority seldom exceeded a third of the members present.

The Duke of York.

But the attention of Parliament and the public was withdrawn even from this interesting question, and absorbed by the charges against the Duke of York, brought forward by Colonel Wardle, on evidence given or procured by Mrs Mary Anne Clarke, a forsaken mistress of the Duke. Ministers, unaware of the extent of the proofs, brought the inquiry before the House, instead of referring it to a committee, and a succession of singular disclosures were thus made to Parliament and the public. Of these the most remarkable were produced by the friends of the Duke persisting in examinations begun under an impression of his entire innocence. It is hardly possible to describe how much this subject engaged the public attention during the months of February and March. Of the influence of Mrs Clarke in obtaining commissions from the Duke, and of her disposing of them for money, there could be no doubt. The question was, whether the Duke was apprised of this traffic; and though he might not be aware of its extent, there seems hardly room to doubt that, in certain cases, he suspected its existence. The debate on the collective evidence was uncommonly long, being adjourned from night to night, and exhibiting a great difference of opinion on the part of the speakers. Several resolutions, varying in their degree of reprehension, were proposed; and though those finally adopted condemned only the immorality of the connection formed by the Duke, without asserting his knowledge of the pecuniary abuses, the result was his resignation of the office of Commander-in-Chief. March 19.

The success of this investigation prompted an inquiry into other abuses, particularly the sale of East India appointments, and disclosed a negotiation of Lord Castlereagh to barter a nomination to a Bengal writership, for the return of a member to Parliament. The house declined to proceed to any resolution against his Lordship, (May 5.) or to entertain a motion relative to the interference of the executive government in elections. (May 4.) A Bill for Parliamentary reform, brought in by Mr Curwen, was not directly opposed, but so materially altered in its progress as to be nugatory when it passed into a law. (June 15.) The farther business of the session consisted in the annual votes for the public service, and in motions by Sir S. Romilly, (May 26.) on a subject which has been but lately followed up with effect—the amendment of our criminal law, by lessening the severity, but insuring the application of punishments.

Changes in the Cabinet.

The failure, in autumn, of the expedition to the Scheldt, and the resignation of the Duke of Portland, when on the verge of the grave, led to the disclosure of a remarkable secret in Cabinet history—the attempts made, during several months, by Mr Canning, to obtain, from the Duke of Portland, the removal of Lord Castlereagh from the war department, on the ground of incompetency to the station. On making this mortifying discovery, the complaint of Lord Castlereagh was, not that his brother minister should think with slight of his abilities, but that, during all the time that he laboured against him, he should have maintained towards him the outward manner of a friend. This led to a duel, followed, not by serious personal injury, but by the resignation of both—causing, in the ministry, a blank which, to all appearance, could be filled only by bringing in the leaders of Opposition. An overture to this effect, whether sincere or ostensible, was made by Mr Perceval. Lord Grenville, on receiving it, came to London; Lord Grey, more indifferent about office, answered it from his seat in Northumberland; but both declared a determination to decline taking part in the administration so long as the existing system should be persisted in. Marquis Wellesley, who had gone as ambassador to the Spanish Junta, now returned, and was invested with the Secretaryship for Foreign Affairs. Mr Perceval was appointed *premier;* and the new ministry, feeble as they were in talent, received the support of a decided majority in Parliament, so general was the hatred of Bonaparte, and the conviction that our safety lay in a vigorous prosecution of the war.

Session of 1810—Walcheren Inquiry. Jan. 26.

The Session of 1810 opened on 28th January, and the leading subject of debate was our unfortunate expedition to Walcheren and the Scheldt. A motion leading to inquiry was carried after a close division —195 to 186. And the investigation was conducted chiefly at the bar of the House of Commons, a secret committee being appointed for the inspection of confidential papers. The Earl of Chatham, and other officers concerned in planning or conducting the expedition, were examined. The inquiry lasted several weeks, and disclosed, clearly enough, the imbecility of our commander; but the speeches of the Opposition were pointed, not against the management of the expedition, but against its expediency as an enterprise; not against the general, but the cabinet. In this they were not seconded by the majority of the house. On the policy or impolicy of the expedition being put to the vote, the former was supported by 272, in opposition to 232; and even the less tenable ground of keeping our soldiers in an unhealthy island for three months after relinquishing all idea of an attempt on Antwerp, was vindicated by 253 votes against 232—a decision too remarkable to be forgotten; and which has since stamped this with the name of the Walcheren Parliament. The only ministerial change consequent on the inquiry was the removal of Lord Chatham from his seat in the cabinet, and from the Master-generalship of the Ordnance; but this was in consequence of *privately delivering a statement to the King*—a statement professing to vindicate himself at the expence of Sir Richard Strachan and the navy. The resolution adopted on this occasion was, "That the House saw with regret that any such communication as the narrative of Lord Chatham should have been made to his Majesty, without any knowledge of the other ministers; that such conduct is highly reprehensible, and deserves the censure of the House."

Committal of Sir F. Burdett.

The exclusion of strangers from the gallery of the House during the Walcheren inquiry gave rise to a

discussion, which, though at first unimportant, soon engaged much of the public attention. John Gale Jones, well known among the demagogues of the age, and at that time president of a debating club, animadverted on the House of Commons in a hand-bill, in a style which induced the House to order his commitment to Newgate. A few weeks after, Sir Francis Burdett brought in a motion for his liberation, on the broad ground that the House had no right to inflict the punishment of imprisonment in such a case. Baffled in this by a great majority, Sir Francis wrote and printed a letter to his constituents, denying this power, and applying contemptuous epithets to the Houses. This imprudent step provoked a debate, which ended in a resolution to commit Sir Francis to the Tower. The Speaker issued his warrant; the Serjeant at Arms carried it to the house of Sir Francis, but withdrew on a refusal of Sir Francis to obey. Next day the Serjeant repeated his demand, accompanied by messengers; but the populace had by this time assembled in crowds near the baronet's house, and prevented his removal, until an early hour on the 9th, when the civil officers burst into his house, put Sir Francis into a carriage, and conveyed him to the Tower in the midst of several regiments of horse. Sir Francis brought actions against the Speaker and other officers; but they fell to the ground by non-suits, and he continued in confinement during the remainder of the session.

Among the farther acts of this session were two which regarded Scotland; one for the increase of the smaller church livings, of which none in this part of the kingdom are now under L. 150; the other relative to judicial proceedings, and reducing the heavy expences caused by the compulsory extract of office papers. The Court of Session had been previously divided into chambers by an act passed in 1808; and the trial, by jury, in civil causes, was introduced into Scotland by an act of 1815.

The Session opened in November, more early than was intended, in consequence of the mental indisposition of the King. Repeated adjournments, however, took place in the vain hope of a recovery, and it was not till 20th December that resolutions for a regency were moved in both Houses. They formed the chief subject of discussion during the ensuing month. Their principal characteristics consisted in the restrictions imposed on the Prince for the succeeding year, during which he was not permitted to confer the rank of Peer, to grant an office in reversion, or even a place or pension, except during the King's pleasure; while the management of the royal household was vested in the Queen. Resolutions so obnoxious to the Prince called forth a strong opposition, and a motion that the royal power should be conferred on him without restriction, was supported by 200 against 224. But the divisions in favour of ministers became stronger after the question of the regency was settled, and great part of the Session passed without any contest between Government and the Opposition; the latter considering the present arrangement as temporary; an opinion in which they were confirmed by the language of the Regent, who entered on his functions, by declaring, that he continued ministers in office solely from a feeling of filial respect. Among the successive topics of discussion were the county meetings of the Catholics in Ireland, and the steps taken by Government to repress them;—an act to authorize Government to send English militia into Ireland, and Irish militia into England; and, finally, the reappointment of the Duke of York to his office of Commander-in-chief—a step which excited some surprise, but received the decided support of Parliament; a motion made to censure it being negatived by 249 to 47. But the most anxious topics of parliamentary and public attention were the distress of trade and the state of our paper currency. Towards the relief of the former, an issue of exchequer bills was authorized under certain limitations; and to support the credit of the latter, a law was passed, which, when joined to former enactments, had nearly the effect of making bank notes a legal tender.

The Session opened on 7th January, and the early discussions related to arrangements for the royal household, and to a motion by Mr Brougham to exclude the *droits* of Admiralty from the Civil List. In this he was unsuccessful, and a similar fate attended a motion by Lord Morpeth, for an inquiry into the state of Ireland, with a view to admitting the Catholics to political rights. The next measures of general interest were two acts against *frame-breaking*,—a practice which the Nottingham workmen, pressed by the loss of the American market, and the consequent fall of wages, had carried to an alarming length. The public attention was soon after engaged by ministerial changes. Marquis Wellesley finding himself unable to lead the Cabinet, or to prevail on his colleagues to extend the scale of our operations in Spain, resigned in February the secretaryship of foreign affairs, and was succeeded by Lord Castlereagh. The restrictions on the power of the Regent now drawing to a close, consistency required an overture for the admission into office of the leaders of the Opposition, intimate as they had been in former years with his Royal Highness. This prompted the well known letter of 13th February from the Prince to the Duke of York, professing a wish to unite with the present ministers "some of those persons with whom the early habits of his public life had been formed." The answer of Lords Grey and Grenville explained their reasons for declining a union with an administration differing so much from them in the most important points of national policy,—the claims of the Irish Catholics; the Orders in Council; and the over issue of bank paper. With this explanation the correspondence closed, and the ministry proceeded unchanged until the assassination of Mr Perceval; when Lord Liverpool succeeded to the first station, and was directed by the Prince to make an overture to Marquis Wellesley and Mr Canning. This led to nothing; and a motion made in the House of Commons to address the Regent, "praying him to appoint an efficient administration," was carried by 174 against 170. This unexpected vote necessitated a

Parliamentary Proceedings. | Sir F. Burdett. | April 5. | Scottish Clergy and Judicature Acts. | Session of 1810-11. | The Regency. | June 6. | April. | July. | Session of 1812. | May 11. | May 21.

Parliamentary Proceedings. second overture to the Opposition, the management of which was committed first to the Marquis of Wellesley, afterwards to Lord Moira. It now seemed highly probable that the Opposition would come in; yet the negotiation entirely failed, in consequence partly of existing animosities, partly of the stiffness of Lord Grey, partly, perhaps, of a secret reluctance in the court to admit the Opposition. Lords Liverpool and Castlereagh remained in office with all the benefit of a declared readiness, and of an apparent unreasonableness in the demands of Opposition.

Orders in Council. The most urgent question now before Parliament was the continuation or repeal of the Orders in Council. The distress of the manufacturers had become general, and had led, among the lower orders, to commotion and riot, among the higher, to petitions to Parliament complaining of our pertinacious adherence to these Orders as the cause of the loss of the great market of the United States. An inquiry was instituted on the motion of Mr Brougham. It was conducted by him, with astonishing knowledge and talent, during several weeks, and every step in its progress gave the evidence a more serious aspect. Still there was a prevailing disposition to cling to those measures, when the accession of Lord Liverpool to the leading station in the Cabinet produced their repeal, though unfortunately too late to prevent the American war. June.

Session of 1812-13. Though Parliament had sat during five years only, the victory of Salamanca and our other successes in Spain afforded ministry a favourable opportunity for appealing to the people. A dissolution was proclaimed on 29th September, and on 30th November the new Parliament was opened by the Regent in person, who spoke for the first time from the throne. Our partial reverses in the close of the campaign in Spain, and the murmurs of Marquis Wellesley and Mr Canning at the inadequacy of our financial contributions to the Peninsular contest, were silenced by the cheering intelligence from Russia, whence Bonaparte was now retreating with great loss. In the progress of the session, the attention of the House and the public was strongly excited by an appeal from the Princess of Wales to Parliament, demanding an investigation of her conduct. This led to a motion for a copy of the Report delivered by the noblemen charged with the inquiry of 1806; and this motion being negatived, the result was the publication, in the newspapers, of a succession of papers relating the whole transaction. These papers, however indicative of want of discretion on the part of her Royal Highness, produced, on the whole, an impression in her favour, as unjustly attacked in her honour. The most interesting debates of the session related to the Catholic question, and the renewal, with important changes, of the Charter of the East India Company. The new Charter, granted for twenty years from 1814, reserved to the Company the exclusive trade to China, but laid open to the public, with slight qualifications, the trade to all other parts of the east. Among the minor proceedings of the session were an act for lessening the endless delays of Chancery by appointing a Vice Chancellor; and an act, which, if it did not enforce Clerical residence, held out a strong inducement to it, by obliging incumbents to increase the stipends of their curates. After granting ministers a liberal vote of credit, Parliament was prorogued on 22d July, amidst a general hope of favourable intelligence from the Continent; Spain being nearly delivered from the invaders, and the Germans having risen with ardour to assert their independence.

Princess of Wales. Feb. 24, 1813.

East India Charter.

Session of 1813-14. These cheering expectations were happily realized in the course of the autumn, and Parliament reassembled on 4th November with the knowledge that the victories at Leipsic had secured the independence of Germany, and enabled our allies to shake the throne of the usurper. There was but one opinion, that at such a juncture every exertion, whether financial or military, should be made to complete the deliverance of the Continent. All the propositions of ministers were adopted, and on 17th November Parliament adjourned to 1st March; evidently in the hope that, before that period, the advance of the allied arms into France would lead to a general pacification. This result, justified by sound calculation, was delayed by the precipitancy of the Prussians, and the consequent checks received by them and their allies; so that Parliament, on meeting on 1st March, adjourned to the 21st, and, on their assembling at that date, Lord Castlereagh being still absent on the Continent, the business transacted during several weeks was of inferior interest. Next came the discussions on the corn trade; the budget of the year, and an additional measure for the preservation of tranquillity in Ireland. A general pacification had by this time taken place, and the arrangements of ministers afforded little opening for animadversion, except as to the compulsory transfer of Norway from Denmark to Sweden. That question was warmly debated in both Houses, and a motion relative to it, made in the House of Lords by Earl Grey, in a speech of uncommon eloquence, received the support of 81 votes against 115. The farther proceedings of the session were an address, praying the Regent to interest himself with foreign powers for a prompt and general abolition of the slave-trade; a vote of L. 400,000 in addition to the L. 100,000 of the preceding year to the Duke of Wellington; and grants, but on a far smaller scale, to Generals Graham, Hill, and Beresford, now raised to the peerage. On the Princess of Wales a settlement of L. 35,000 was definitively made.

Session of 1814-15. Parliament assembled on 18th November, and, after the transaction of some business relative chiefly to keeping the English militia embodied, and preserving the peace of Ireland, adjourned on 2d December. They met again on 9th February, and were soon after called on to discuss a most important department of home policy,—the Corn Laws. The prospect of the return of peace and of large imports of corn from the Continent, had early excited the attention of the landed interest; and a committee, appointed in the spring of 1813, had made a report to Parliament recommending the prohibition of foreign corn, except when wheat at home should be at or above the very high price of 105s. the quarter. No proceedings on the subject took place that session, and next year the sense of Corn Laws.

rliament- Proceed-ings.

y 5, 1814.

the public was so unequivocally declared against this extravagant proposition, that a great reduction was indispensable; and, on bringing forward the resolutions connected with the subject, it was proposed to allow the import of foreign wheat whenever our own should be at or above 87s. Still this limit appeared too high; the debates were warm, the petitions against the bill numerous; and, ministers suspending their support, the main part of the question was adjourned to next year. In the summer and autumn corn underwent a great fall, and the farmers experienced much distress; the consequence of which, and of the evidence given before the Parliamentary committees, was, that Government determined to support a corn bill on a reduced scale, foreign wheat being admissible when our own should be at or below 80s. Resolutions to that effect were moved (see our article on the CORN LAWS) on 17th February, and a bill founded on them was soon after brought in. It still experienced opposition, particularly from Mr Baring and others, who argued that the limitation price ought not to be permanent, but subject to a graduated abatement during a series of years, till at last the corn trade should arrive at that unrestrained state so essential to commerce at large. But notwithstanding these arguments, and a tumultuous opposition without doors, the bill was carried by large majorities in both Houses.

turn of naparte m Elba.

But from discussions of internal policy, the attention of Parliament was suddenly directed to a more urgent topic,—the return of Bonaparte from Elba, and a notice of an immediate augmentation of our forces. An address to the Regent, in support of this augmentation, was carried by great majorities;

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and a subsequent motion, by Mr Whitbread, to prevent our interference for the reinstatement of the Bourbons, was lost by 273 against 72. Finally, the addresses in approbation of the treaties with the Continental powers were supported by Lord Grenville, Mr Grattan, and other oppositionists; the numbers in the Lords being 156 against 44; in the Commons, 331 against 92. Next month brought intelligence of the battle of Waterloo, which was followed, in a moment of exultation, by a grant of L.200,000 to the Duke of Wellington, making the sum total voted to his grace L.700,000. The farther proceedings were an approval of the treaty of peace with America, and of the very questionable transfer of Genoa to the King of Sardinia: the session was concluded by a repeal of the law for fixing the price of bread in London by Assize.

ssion of 16.

Parliament met on 1st February, and, after some business of minor importance, proceeded, in March, to discuss the interesting question of our military peace establishment. The navy had been reduced with sufficient promptitude, but there seemed, on the part of Government, a disposition to keep the army on a scale neither required by the general tranquillity of Europe, nor justified by our financial means, which exhibited several symptoms of decline. Yet a motion for so moderate a reduction as 10,000 from the proposed number of land forces, was negatived by 202 to 130; and, in long debates that ensued relative to the army estimates, ministers carried every point, and were likely to keep up the whole on an expensive scale; when, on 18th March, after a long and animated discussion, the question of continuing the property-tax, modified to *5 per cent.*, was decided against them by a majority of 37; there being 238 against 201. This signal and unexpected defeat necessitated a relinquishment of the war malt duty, and a general reduction of expenditure, which we should have in vain expected from the reason or reflection of our rulers.

Parliamentary Proceedings.

Loss of the Property-Tax Bill.

Another measure of importance was the regulation, after a long investigation, of the civil list, on a footing which was adopted as a standard on the beginning of the present reign. This was followed by acts for the consolidation of the English and Irish Exchequers; for the exemption of the bank from cash payments during two years; and, finally, by an act for striking off a new silver coinage. Among the minor proceedings of the session was a grant of L. 60,000 a year to the Princess Charlotte and her husband, with a provision, unfortunately too soon required, of L. 50,000 to the latter in the event of her demise.

Session of 1817.

A general want of work and reduction of wages continued during the year, subjecting the lower orders to great distress, and exposing them to the arts of designing demagogues. Large assemblages, particularly in Spafields, took place previous to the meeting of Parliament; and, on the day of its opening (28th January) the Regent was insulted on his way to the House. A secret committee of each House was soon after appointed to examine papers in the possession of Government, bearing evidence of serious projects of insurrection, and each made a speedy report, declaring the existence of very dangerous societies. There was, in these reports, a strain of confident allegation, unaccompanied by specific proof or temperate reasoning, which brought to recollection the declamatory state papers of the French Revolution, and gave the reports the appearance of documents framed to disseminate alarms, and justify extreme measures. They engaged, however, the serious attention of the House, and the result was a bill for the suspension of the *Habeas Corpus* act during the current session of Parliament,—a measure carried in the Lords by 150 to 35; in the Commons by 265 to 103. Towards the close of the session, a second report from the secret committees produced an act for continuing the suspension of the *Habeas Corpus* to 1st March 1818.

Suspension of the Habeas Corpus

May 1817.

The continued want of work, and distress of the lower orders, led to an act for authorizing the issue of Exchequer Bills to persons finding employment for the poor. The same causes inducing the public to call loudly for retrenchment; the Opposition took, on 25th February, the sense of the House of Commons on a motion to reduce the number of the Lords of the Admiralty, and mustered 152 votes against 208. As an offering on the part of Government to the prevailing call, an act was passed for abolishing the two sinecure offices of Justice in Eyre.

Mr Abbot, who had filled the office of Speaker of the House since 1802, finding himself incapable, from continued indisposition, of performing its ar-

Parliamentary Proceedings. duous duties, sent in his resignation, and was succeeded by the Right Honourable Charles Manners Sutton. Mr Abbott was forthwith raised to the peerage by the title of Baron Colchester, and, on 6th June, a vote passed the Commons for settling on him a life annuity of L. 4000.

Session of 1818. Parliament was opened on 27th January, under circumstances which indicated that the want of work and distress of trade, though still considerable, were less serious than in the preceding year. A secret committee, appointed anew by each House, reported to that effect; and, on their recommendation, was brought in a bill to indemnify persons (chiefly magistrates) who had acted in apprehending and detaining individuals suspected of treasonable practices: this bill was not carried without considerable opposition.

Increase of Income to the Royal Dukes. The death of the Princess Charlotte having caused a blank in the succession to the Crown, the marriage of the Royal Dukes became a subject of consideration; but the provision for any increase of expenditure was exposed to difficulty, as well from the distress of the public, as from the near approach of the time when the members were to meet their constituents. April 15. A motion, made by ministers, to grant L. 10,000 additional to the Duke of Clarence, was not successful; an amendment for reducing it to L. 6000 having been carried by 193 to 184. Votes, equally restricted, were passed in the case of the Dukes of Kent and Cambridge; and an attempt to obtain a similar grant to the Duke of Cumberland (who had been several years married) was negatived by 143 to 146; but a provision of L. 6000 a year was made for the Duchess in case she should survive him.

Among the other transactions of this year was a grant of L. 400,000 to Spain, as a compensation for losses attendant on an early abolition of the slave-trade by that power. Certain acts were also passed for the humane treatment of negroes in our sugar colonies. The bank exemption act being about to April 9. expire, Mr Vansittart brought in a bill for continuing it another year, on the ground that the loans now contracting in England for France and Prussia carried capital out of the country, and prevented the bank, for a time at least, from diminishing its paper circulation.

Public Charities. Mr Brougham having, early in the session, brought in a bill for investigating the abuses of Public Charities, it was referred to a committee, and, after some discussion in the Commons, passed to the Lords. There it encountered opposition from Lords Eldon and Redesdale, and was returned to the Commons with material alterations; the commissioners charged with the inquiry being limited in their powers, and restricted to charities connected with education. The act, however, passed in this state, and the labours of the commissioners, like those of the committee on the education of the poor, have been productive of much public advantage. The session was closed on 10th June by a speech from the Regent, containing a notice, not only of the prorogation, but of the dissolution of Parliament,—a measure which for many years had been announced by proclamation.

The new Parliament met on 14th January 1819, and on 21st proceeded to business. Parliamentary Proceedings. Session of 1819. The demise of the queen having taken place during the recess (17th November), one of the first measures was to vest the custody of the King's person in the Duke of York, who, very imprudently, under the circumstances of the country, demanded and received from Parliament an annual allowance of L. 10,000 for discharging an act of filial duty. This formed a striking contrast to the conduct of the Marquis of Camden, who, possessed of the lucrative sinecure of Teller of the Exchequer, relinquished L. 9000 a year of it to the public,—a sacrifice noticed in honourable terms in a vote passed in Parliament on the occasion.

Strength of the Opposition. Such was the addition given to Opposition, by an election under circumstances of general distress, that several measures were carried in this session against ministers; in particular, a motion on 2d March, by Sir James Mackintosh, for a revision of the criminal code, where the numbers were 147 against 128; and a motion for a committee on the state of the Scottish May 6. Burghs, carried by 149 to 144. In the division on the grant of L. 10,000 to the Duke of York, the Opposition mustered 186 votes against 281. But the impression excited by these successes was greatly enfeebled by a motion, which arrayed on one side all the strength of Government, and that of the neutral party. We allude to Mr Tierney's motion for May 18. an "inquiry into the state of the nation," which was negatived by 357 to 178—a division, evincing that, though disposed to co-operate with Opposition occasionally and for specific objects, the neutral party had no wish for a change of Ministry. Encouraged by this success, Mr Vansittart came forward with the bold proposition of new taxes, to the extent of The New Taxes. L. 3,000,000, on the ground of a sum of that amount being absolutely necessary to give efficiency to the Sinking Fund. Of this sum the chief part was expected from an increase of the duties on malt, spirits, and tobacco; but part also was to be derived from a tax on foreign wool (6d. *per* lb.); a most singular impost in a country where the export of manufactured wool forms a main branch of the national industry. Ministers were conscious of its injurious tendency, but were obliged to bring it forward as an equivalent to the landed interest, for the fresh burden exacted from them in the malt-duty.

The farther debates of the session related to the Catholic question, and the resumption of cash payments. In the contest pending at this time between Spain and her American colonies, Ministers took part with the mother country, so far at least as to discourage, by act of Parliament, the enlistment of our officers and soldiers on the side of the insurgents. In the preceding session, L. 1,000,000 New Churches. had been voted for building additional churches and chapels for the established worship in England; and this year, L. 100,000 was appropriated June 30. for a similar purpose to the established church of Scotland. The last act of the session was a grant made in July of the limited sum of L.50,000, to be shared by government among persons settling, on particular conditions, at the Cape of Good Hope. This was the first pecuniary aid given by government towards emigration, which is accounted by

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some the only remedy for our present overstock of labourers and manufacturers.

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The revival of commercial activity, in 1818, proved unfortunately of short duration. Distress returned towards the end of that year, and assumed an aggravated aspect in the course of 1819. This produced popular assemblages, and led, on 16th August, to an unfortunate scene at Manchester, in which the interference of the Yeomanry Cavalry, to disperse a very numerous meeting of the people, was productive of loss of life to several persons, and of bodily injury to many. The irritation excited among the lower orders by this proceeding, and by the continued pressure of poverty, led to the dissemination of a spirit of discontent and insurrection, which necessitated the assembling of Parliament on 23d November. The speech of the Regent, as well as the discussions of both Houses, were directed to this painful subject; and the alarm excited among the aristocracy, joined to other considerations, having finally detached the Grenville party from the Opposition, the latter now mustered in less formidable array. On the division for an amendment upon the address to the Regent, the numbers were 150 against 380.

Several bills were afterwards introduced by Ministers for the prevention of disturbances. These consisted in imposing a tax on the petty publications circulated among the lower orders; impeding the circulation of libels; authorizing the seizure of arms; and forbidding military training, or seditious meetings. These bills produced long and animated debates; but the most considerable division on the side of Opposition (for limiting the act against seditious measures to three years, instead of five) consisted of

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only 150 votes against 328. A motion of a more comprehensive nature, for a committee on the state of the country, was negatived in the Lords, by 178 to 47; in the Commons, by 395 to 150.

After transacting this and other business of an urgent nature, Parliament adjourned; but was soon after brought together by an event, which, however conformable to the course of nature, was not at that time expected—the death of George III. The day after the demise, agreeably to established usage, both Houses met, and took the oath of allegiance to the new Sovereign. On the 2d February, they adjourned till the 17th, the day after the interment of his Majesty. On that day, both Houses voted an address of condolence to the present King, after which they proceeded to transact such business as was pressing, and might, according to law, have continued to sit during six months; but Ministers judged fit to resort to a dissolution. Another election now took place under circumstances of general distress. The new Parliament met on the 21st April, and was opened on the 27th by George IV., in a speech, declaring his anxiety for strict economy; but regretting, that the state of the country was such as to admit of no reduction of the military force.

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The peace of Amiens at first gave hopes of the improvement of Ireland by the introduction of British industry and capital; but these hopes were soon clouded by the renewed contest of 1803. In that contest, the public in England and Scotland joined with almost unexampled zeal; Ireland was less cordial; but it would be altogether erroneous to connect with any political party, whether Catholic or Protestant, the miserable insurrection of 23d July 1803. A plot to seize Dublin, almost as extravagant as that of the late Cato Street conspiracy in London, was framed by a few infatuated individuals; and in the tumult, which burst forth with great violence, but feeble means, Lord Kilwarden, the Chief Justice, unhappily lost his life. A party of military soon dispersed the rabble, and of their leaders, most of whom were afterwards apprehended and executed, the only one entitled to notice was Emmett, a young man, whose education and talents ought to have placed him above such desperate attempts. The alarm thus excited, engaged, some time after, the attention of Parliament, and led to the enactment of two bills, one for a renewed suspension of the Habeas Corpus act in Ireland, the other for trying rebels by martial law.

Ireland.

December 1803.

The encouragement so generally given to the volunteer system in England and Scotland was not extended to Ireland, from a dread of embodying, indiscriminately, a people of whom so great a proportion were disaffected. The yeomanry, however, or select volunteers of Ireland, were very numerous (about 80,000); and had been highly instrumental in putting down the unfortunate insurrection of 1798. In addition to these, Ireland required a large body (50,000) of our regulars and militia, as a defence against invasion, a guarantee of public tranquillity, and a check on illicit distillation and smuggling. The return yielded by Ireland in the shape of revenue was small, but her supply of recruits to our army and navy was very considerable.

Catholic Question.

The suspension of the Habeas Corpus continued in 1805, a year remarkable as the first in which the Catholic question was submitted to Parliament. It was brought forward in the Commons by Mr Fox, in the Peers by Lord Grenville, and curiosity was strongly excited in regard to Mr Pitt, who had lately accepted office without carrying his professed object,—the grant of political privileges to the Catholics. He, however, extricated himself with address; declaring, that if his vote could give the Catholics what they desired, they should not long want it, but that at present the prevailing sentiment was against their claims; as was, in fact, sufficiently shown by the division that ensued, and which exhibited 336 votes against them, and only 124 in their favour. Next year, the appointment to office of Lord Grenville and Mr Fox raised high the hopes of the Catholics; but the known repugnance of the Sovereign to their claims induced these ministers to dissuade a direct discussion of the question in Parliament; under an assurance, that they would do whatever should be otherwise practicable for obtaining the removal of disabilities. Hence the bill of February 1807, which caused the dismissal of the Grenville ministry, and excited such a ferment in England against the Catholics, as to render it wholly unadvisable to bring forward the question for several years.

In 1809, the Catholic Committee in Dublin held public meetings, but confined themselves to preparing a new petition to Parliament. Next year they went much farther, and sought to assume an imposing attitude; proposing that ten persons should be

Ireland. deputed by each county to Dublin, and there form an assembly, charged not only with the petition to Parliament, but with measures for the redress of the general grievances of the Catholic body. The secretary for Ireland (Mr Wellesley Pole), alarmed at this design, addressed circular letters to the sheriffs of counties, requiring them to prevent the election of the proposed delegates, and even to arrest all persons taking part in such elections. This order appeared too peremptory to the Opposition, and a
March 3, 1811. debate took place, in which Mr Wellesley Pole explained, that, so long as the Catholics confined their proceedings to petitioning, they had received no interruption, but that the delegates proposed to go much farther, and that a body, under the name of a Committee of Grievances, had assembled weekly in Dublin with all the forms of Parliament. The House supported the measure adopted by Mr Wellesley Pole, and disapproved the proceedings of the Catholics. Still the latter deemed this session not unfavourable to the discussion of their political claims, on account of the laurels lately won by our armies in Spain and Portugal,—armies which counted many Catholics in their ranks. The question was brought forward by Mr Grattan, but lost by a large majority in both Houses.

April 1812. The same fate attended its discussion next spring. Another year elapsed; and in the session of 1813, it was brought forward with more combination and better prospects. Mr Grattan, supported by a part
Feb. 25. of the Cabinet, obtained the assent of the House to several preliminary resolutions; *first*, " That the Catholic disabilities ought to be removed;" *next*, That the " Catholic clergy should bind themselves on oath to hold no correspondence with Rome except on ecclesiastical business;" and, *thirdly*, " That two commissioners should be appointed for examining into the loyalty of persons recommended as deans or bishops among the Catholics." The time occupied in these discussions was considerable, and gave occasion to the Catholic clergy in Ireland to testify their dissent from several of the provisions; particularly from that which restricted their correspondence with Rome. The knowledge of this dissatisfaction made a deep impression on Parliament, and gave a turn to the question, which induced the supporters of the bill to withdraw it for that session. Ireland. May 24.

The ensuing year unfortunately gave farther evidence of the want of temper and union among the Catholics. The court of Rome recommended their acquiescence with the propositions of Mr Grattan; but meetings of the Catholic Board at Dublin disclaimed indignantly all foreign interference; and the clergy passed resolutions against the appointment of any Catholic bishop by the British government. The intemperate proceedings of the Catholic Board now led government to dissolve that body, and declare its meetings contrary to law. June 3, 1814.

These dissentions prevented the question from being submitted to Parliament in 1814. Next year it was brought forward by Sir H. Parnell, not by Mr Grattan, who declared that an unconditional grant of the demands of the Catholics was not to be expected, and that, without cultivating a spirit of conciliation, they never would succeed. The motion was lost by a great majority. In 1816, it was again brought before Parliament, but in two distinct petitions, of which the more temperate, introduced by Mr Grattan, received the support of 141 votes against 172.

Next year (1817) the question was proposed by Mr Grattan, with the same views as in 1813, and supported by 221 votes against 245. The disappointment of failure was soothed not only by the large minority, but by a very substantial concession obtained soon after, on the proposition of ministers, viz. an act to enable Catholic officers in the army and navy to attain rank nearly on the plan proposed by the Grenville ministry in 1807. In 1818 the Catholic question was not agitated; but in 1819 the tone of that body being more conciliating, Mr Grattan's motion for taking it into consideration was supported by 241 votes against 243.

Table showing the Times and Results of the Parliamentary Discussion of the Catholic Question, since 1805.

		House of Lords.			House of Commons.		
		For.	Against.	Majority.	For.	Against.	Majority.
1805.	Motion for taking into consideration the Petition of the Irish Roman Catholics,	49	178	129	124	336	212
1806.	Not brought forward in consequence of Mr Fox's advice.						
1807-8-9.	Not brought forward.						
1810.	Motion for a Committee of the whole House,	68	154	86	109	213	104
1811.	The same,	62	121	59	83	146	63
1812. April 21.	The same,	102	174	72	215	300	85
July 1.	For taking it into consideration next year,	125	126	1	235	106	129
1813. Feb. 25.	For a Committee of the whole House,				264	224	40
March 9.	For leave to bring in a Bill for removing disqualifications, &c.				186	119	67
May 11.	For a Select Committee,				189	235	48
— 13.	A Motion against the Bill negatived,				245	203	42
— 24.	A Motion (by the Speaker) for omitting the words in the bill, " To sit and vote in either House of Parliament," *(Not debated in the Lords this year.)*				251	247	4
1814.	Not brought forward.						
1815.	For a Committee of the whole House,	60	86	26	147	228	81
1816.	For consideration next year,	69	73	4	141	172	31
1817.	For a Committee of the whole House,	90	142	52	221	245	24
1818.	Not brought forward.						
1819.	For a Committee of the whole House,	106	147	41	241	243	2

Ireland || Greece.

Our victory at Trafalgar was of particular importance in regard to Ireland, as it relieved her almost entirely from the dread of invasion; but the seeds of discontent, disorder, and insurrection, still continued. In 1807 it became necessary to renew the power given to the Lord Lieutenant, to proclaim counties in a state of disturbance, and to authorize magistrates to arrest persons found at a distance from their homes at night; also to prevent suspected persons from keeping arms. This act, which has since been repeatedly renewed, proved a security against any general commotion; but it could not prevent the disorderly from entering into associations which, at one time under the name of "Threshers," at another of "Carders," at another of "Ribbon Men," have so long excited, and still continue to excite, disquietude and dread in that unhappy country.

Acts passed against Insurrection.

Ireland bears a strong resemblance to some countries of the Continent, in the petty size of farms, the poverty and wretchedness of the lower orders, the want of mercantile capital, and of manufacturing towns. These are the features which strike the traveller in Brittany, in the south of France, and in great part of Italy—countries long governed with the same inattention to the welfare of the people as Ireland. In them, however, the religion of the inhabitants is that of the government; their pastors inculcate loyalty, and derive their support from the state; while, in Ireland, to all other causes of backwardness, has been added that of incessant jealousy between the government and the spiritual guides of the majority of the people. Hence a general and hereditary discontent, and a no less general ignorance, the result of the want of all kindly intervention from government in regard to education. But the discussion of this painfully interesting topic, will find a more fitting place in the article IRELAND. (D.D.)

GREECE.

Introductory Observations.

GREECE and its inhabitants, after a long period of oblivion, have at length become objects of profound and general interest to the most enlightened nations of Europe. It was singular, indeed, that while classical scholars were immersed in the study of its poets, orators, and historians, the country that gave birth to so many literary treasures, though neither distant nor inaccessible, seemed to have been as completely forgotten, as if it had been blotted from the map of Europe. The learned contented themselves with supposing, that the modern country was inhabited by rude and unknown tribes, governed by fanatical Turks, whose barbarous rule exposed travellers to continual insults and pillage, and had swept away all traces and memorials of the ancient glory of Greece. Besides, the country was not known to be distinguished by its natural beauties; and being confounded with the torpid mass of the Ottoman empire, its political importance was reduced to nothing. Till a very late period, the only intelligible accounts we had of the country were drawn from Strabo and Pausanias. The inquiries of Spon and Wheler, Le Roy, and Stuart, which at length brought some of its precious antiquities to light, were chiefly addressed to artists and scholars. Chandler's *Travels* were not much better adapted for general use. But the work which, more than any other, contributed to render all subjects connected with Greece and its antiquities popular, was the *Travels* of Anacharsis. Previous to the appearance of this work, however, various circumstances had contributed to bring the Greeks more conspicuously forward on the theatre of European affairs. While the general diffusion of education was increasing the number of those who felt an interest in classical subjects, the rise of the power of Russia, the connection she endeavoured to form with the Greeks, and her projects against Turkey, held out a probability, that Greece might speedily regain some share of political importance. The Greeks themselves, by the desperate efforts they made in 1770, and again in 1790, gave a proof to the world, that their existence as a people, and their national feelings, had survived those destructive revolutions which were supposed to have overwhelmed them. When the political enthusiasm, created by the French Revolution, made the most gigantic plans of political change appear easy, the emancipation of this long neglected country from the Turkish yoke was looked to as one of the most certain and gratifying triumphs of the new principles. Before the interest arising from this state of things had expired, circumstances of a different kind directed public attention more immediately to Greece. The host of English travellers who had been accustomed to roam over the Continent, shut out from their usual routes by an extraordinary combination of events, were forced into less frequented tracts, and numbers of them visited Greece. By these, and by a few individuals from other parts of Europe, a great part of the country has been explored, and a vast mass of information given to the public. Its topography and statistics are now better known than those of many of the nearer and more accessible parts of Europe. The revolutionary schemes, though not forgotten, have lost their importance; but the classical interest of the country has been augmented tenfold, by vivid descriptions of its monuments and its scenery, which have rendered many of the great events in its history familiar, as it were, to the eye. It is now found, that Greece may be visited with as much ease and security as Italy, or any other country in the south of Europe; that the modern Greeks, instead of being the mixed progeny of obscure and barbarous tribes, possess a respectable degree of civilization, and great capacities of improvement; that they have preserved the features and national character of their ancestors with surprising distinctness; and that their dialect does not deviate much farther from the language of Plato and Demosthenes, than that of Chaucer does from the English of the present day. Independently, too,

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of its other attractions, Greece surpasses Italy, and perhaps every other country in the world, in the beauty of its scenery. Its antiquities are not like those of the latter country, accumulated chiefly upon a single spot. They are scattered over a wide surface,—associated with a variety of scenery,—presenting memorials of many separate people, distinguished by differences of character, habits, and civilization. Its monuments, compared with those of Rome, breathe a purer taste, a finer moral spirit, and bespeak a sublimer genius; they tell of brighter and better times; of characters and actions, more surprising, generous, and romantic. Some of them transport the mind back to those remote times, where truth and fable are blended,—to those delightful fictions which bear the impress of the genius of the people more distinctly than the real events of their history. No country, in short, presents greater attractions to a well informed traveller; and as, in future, it will certainly be included in every classical tour, we may reasonably expect that, in a short time, every part of it will be completely explored.

Name.

The name of Greece was originally restricted to a small territory northward of the Gulf of Corinth, called also Hellas. Afterwards it included Attica, Eubœa, Peloponnesus, Epirus, and Thessaly; and ultimately Macedonia and Crete. In the brilliant periods of Grecian history, the extent of the country might be considered as coincident with the limits of those states which sent deputies to the Amphyctionic Council; and, in this sense, Etolia and Acarnania, as well as Epirus, Macedonia, and Crete, ought to be excluded.* But, though we shall notice these divisions, our object at present is rather to take the appellation in its most extensive sense, and to follow what may be considered the natural limits of the country; because the territories included within these limits are associated by certain political relations; and because many of the most interesting subjects of inquiry and discussion relating to the ancient, and still more to the modern state of Greece, connect themselves most naturally with this arrangement.

Extent.

The Continent of Greece, including Albania and Macedonia, is nearly shut in on the north by a chain of mountains known anciently by the names of Rhodope, Scomius, and Orbelus; † it is bounded on the west by the Adriatic and Ionian Seas, on the south by the Mediterranean, and on the east by the Ægean Sea, or Archipelago. It extends from 36° 10′ to 42° 40′ of north latitude; and from 19° 45′ to 24° 40′ of east longitude from London. Its length, from Cape Matapan to Mount Orbelus, or Argentaro, is 450 English miles; its greatest breadth, from Durazzo to Cavale, at the foot of Mount Pangœus (a branch of Rhodope), 235 miles; and it embraces an area of 57,750 square miles, exclusive of all its islands except Eubœa. But, as our ideas of the extent of the country have always a reference to those ancient states which comprised but very minute portions of its surface, it is necessary that its dimensions should be described more in detail.

Ancient Limits and Divisions.

The country recognized as Greece before the rise of the Macedonian power, comprehended the Morea or Peloponnesus, Attica, Eubœa, Bœotia, Phocis, Doris, Etolia, Acarnania, Thessaly, and Magnesia; and even several of the states included within these limits had little or no share in those splendid actions which have shed so much glory over the country. The surface of Peloponnesus, which included seven different states, is about 8950 square English miles, in Danville's map; that of the countries just named, without the peninsula, including Eubœa, is 14,800; and both together amount to 23,750 square miles; an extent of surface not exceeding two-fifths of England, or one-fifth of the British isles. If to this we add 16,000 square miles for Albania or Epirus (including the basin of the Drino), 18,000 for Macedonia, and 1000 for the Cyclades, the whole surface of Greece and its islands will be 58,750 square miles, which is almost exactly the area of England. While Greece preserved its independence, however, all these territories were never united into one body politic, nor was their confederated force ever applied to the prosecution of any common enterprise. The communities whose warlike achievements, and brilliant career in arts and philosophy, raised the Grecian name so high, occupied but very minute portions of these territories; as the following table, deduced from measurements on Danville's map, will show.

	Sq. Eng. Miles.
Attica, including Megaris and Salamis, but not Eubœa, ‡	1190
Bœotia,	1530
Laconia (without Messenia),	1720
Achaia (the twelve cities with their territories),	1140

These states, therefore, were, in general, about equal in extent to middle-sized English counties. None of them were so large as Norfolk or Devonshire; and the two adjoining counties of York and Lancaster were nearly equal to the whole seven states of the ancient Peloponnesus. Attica, indeed, besides possessing at one period Eubœa, had many colonies in the Cyclades, Thrace, and other parts; and Sparta held Messenia long in subjection; but, in great struggles, these colonies and dependencies

* Cluver, *Geog.* Lib. iv. Cap. 6.—Strabo, Lib. viii.—Potter's *Antiq.* B. i. Chap. 16.

† Throughout this article, we use the ancient or the modern names, according as either happens to be better known than the other. In general, the ancient divisions of the country being more minute, and more accurately defined, than the modern, serve better for the purposes of description. The greater number of modern travellers have felt it necessary to adopt this practice.

‡ In the maps of Barbie du Bocage, Laconia is considerably larger, and Attica and Achaia considerably smaller, than here stated. But we have followed Danville, as his maps are pronounced, by a very competent judge (Sir William Gell), to be much more accurate than any others since constructed.

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often shook off their allegiance, and the parent state was obliged to rely on its own resources. Such was the energy of these small communities, that Attica, which scarcely supports, at present, a miserable population of 20,000 souls, sent out sometimes colonies of 10,000 men at once (Diod. Sic. Lib. 2); and Sparta furnished 50,000 soldiers to fight the Persians at Platæa. The territories of Corinth, when she formed a separate state, were much smaller than any of these; her wealth and power depending chiefly on commerce.

Gulfs and Mountains.

Greece forms a long and rather narrow peninsula, singularly indented on three sides by arms of the sea, and having a greater proportion of its surface occupied by mountains than any other country in Europe of equal extent, except Switzerland. It has been justly observed, that those physical features which distinguish Europe from the other quarters of the world, belong in a peculiar manner to Greece, and distinguish it in the same proportion from the other parts of Europe. Of these arms of the sea, the most considerable are the Gulfs of Contessa, Salonica, Volo, Ægina, and Napoli, on the east; those of Kolokythia and Coron on the south; and those of Lepanto and Arta on the west. Of the mountains, the first in order are those which pass along the northern frontier. Mount Argentaro, the ancient Orbelus, placed at the northern extremity of Greece, near the 43d degree of latitude, may be considered as the centre of the whole system of mountains in European Turkey. From this nucleus, an elevated chain, bearing the names of Scomius and Rhodope anciently, passes south-eastward, and sends off branches on both sides, one of which, Pangeus, advances southward to the Egean Sea, nearly opposite to the Isle of Thasus, and shuts in Greece on the east. From the same central nucleus, another great chain passes south, and south-easterward, under the ancient names of Scardus, Pindus, Cithæron, and Parnes, and terminates at Cape Colonna, the southmost point of Attica. This chain, which includes the celebrated mountains of Parnassus and Helicon, divides the northern continent of Greece into two parts of nearly equal breadth, and gives birth to all the most considerable rivers, which flow off on its opposite sides, but in no instance cross it. On the east side, besides many small lateral ridges, it sends off two principal branches, which enclose Thessaly on the north and south; these are the Cambunian mountains, which, connecting the central ridge of Pindus with the lofty group of Olympus, separate Macedonia from Thessaly; and Mount Œta, which, running eastward to the Maliae Gulf, forms, at its termination, the famed pass of Thermopylæ. Mount Othrys, a little farther north, may be considered as a subordinate chain to Œta. Mount Olympus is separated only by a narrow ravine from Ossa and Pelion, which enclose Thessaly on the east. On the western side of the central chain, the whole country to the Ionian Sea, northward of the Gulf of Arta, is covered by a series of ridges, not running off laterally, but disposed in lines nearly parallel to the central chain, and separated by deep vallies. One of these ridges, nearest the coast, and terminating in a promontory, in latitude 40° 30′, was known anciently by the name of Acroceraunus; another farther north, and more inland, was Mount Tomarus. A long and narrow ridge occupies the Island of Eubœa, and is evidently continued in the outermost chain of islands included under the name of the Cyclades. Another chain of these islands may be considered as a prolongation of the great central ridge from the promontory of Sunium or Colonna.

The mountains in the Morea or Peloponnesus, which are as numerous as in the north of Greece, present rather a singular configuration. A long ridge, bent into a circular form, encloses the central plateau or basin of Arcadia, and five spurs, or subordinate ridges, run off from the different sides of this circular chain to the five prominent points of the peninsula.

Elevation of Mountains.

The elevation of some of the Grecian mountains has been estimated but not accurately measured. Mount Orbelus, the northern boundary of the country, has its summit covered with snow all the year,* and must therefore exceed 8200 feet in height, but none of the other mountains seem to reach the circle of perpetual congelation. The elevation of the great central chain of Pindus, is loosely estimated by Dr Holland at 7000 feet.† That of Olympus, one of the loftiest summits in Greece, was computed by the ancient philosopher Xenagoras to be ten stadia and a plethrum, an elevation not materially different from that of 1017 toises, or 6500 feet, assigned to it by Bernouilli. The famed Parnassus seems to be considered by Dr Clarke and Dr Holland as rising above most of the other Grecian mountains; but as its summit is destitute of snow during a part of the year, its height cannot exceed 9500 feet, and is probably much less. This mountain is still called Parnassu by the peasants residing on it, but in the low country of Livadia, it bears the name of Lakura.‡ The celebrated Athos, which is now the seat of twenty-two monasteries, rises to the height of 713 toises, or 4350 feet. (Walpole, p. 204.) Several of the Albanian mountains are estimated by Dr Holland to be from 3000 to 4000 feet high.

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* *Travels in the Morea, Albania, and other parts of the Ottoman Empire.* By F. C. Pouqueville, M. D. (Translation), London, 1813. p. 443.

† *Travels in the Ionian Isles, Albania, Thessaly, Macedonia,* &c. during 1812 and 1813. By Henry Holland, M. D. 1815. p. 207.

‡ *Memoirs Relating to European and Asiatic Turkey,* edited by the Reverend Robert Walpole, A. M. 1817, p. 72; Clarke's *Travels,* 4th edition. 8vo. 1818. Vol. VII. p. 260; Holland's *Travels,* p. 394. Article CLIMATE in this *Supplement.*

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The elevation of Mount Oleno, said to be the highest summit in the Peloponnesus, according to Scrofani, is 700 geometrical paces, or 3500 feet (*Voyage en Grece,* 1801, Tom. I. Let. xxxi.), and that of Mount Geranion, which separates the two seas at the Isthmus of Corinth, is about 2500 feet. (Holland, p. 419.) These notices, though separately possessing little accuracy, when put together enable us to conclude with considerable certainty, that the highest mountains of Greece are in the northern parts; that the great central chain of Pindus, with its branches, may be considered as corresponding pretty nearly in height with the Carpathians,—as rather higher than the chain of the Apennines,—and as not having more than half the absolute elevation of the Swiss Alps.

Geology.

Nearly the whole surface of Greece is occupied by a great formation of compact limestone, of a whitish or bluish grey colour, approaching, at times, to the nature of chalk. It forms, in some places, long sharp continuous ridges, in others round or craggy summits, and it presents strata highly inclined. It contains a few organic remains, with many flint nodules, and some beds of gypsum on the western side; and occasionally masses or beds of a calcareous conglomerate. The Acropolis of Athens consists of the last mentioned rock. Dr Holland conjectures, that the principal formation may belong to the *first flœtz limestone*, and the gypsum to the *first flœtz gypsum* of Werner. This limestone, which forms the entire mass of Parnassus and Helicon, rests on mica slate near Athens. The hills of Attica consist generally of primitive limestone; and the same species of rock, with clay slate, serpentine, sienite, porphyry, abound in Negropont, the central parts of Pindus, Olympus, and Athos, and all round the Gulf of Salonica. Farther north, in mounts Scomius and Rhodope, granite and gneiss are found.* In general, primitive rocks are most abundant on the east side of Greece; and the west side is characterized by the prevalence of beds of gypsum. It is to the peculiar constitution of this great limestone formation that Greece owes those physical features which so remarkably distinguish the country,—the numerous caverns, fountains, subterraneous river courses, hot springs, and gaseous exhalations, which gave birth to so many of the popular superstitions of the ancients.

Rivers.

The rivers of Greece, flowing within a narrow territory, are much inferior in size even to the larger branches of the Danube. They may be fitly compared with those of Great Britain for the length of their courses and the quantity of water they convey. The classical rivers, however, which are chiefly in the south, are generally mere brooks, such as would find a place only in a county map. The largest rivers in Greece are the Axius, now the Vardar, in Macedonia; the Drinius, now the Drino, in Northern Albania; the Peneus, now the Salympria, in Thessaly; the Achelous, now the Aspropotamo, in Ætolia; the Alpheus, now the Roufia, and Eurotas, now Vasilipotamo, in the Morea. These and some others have permanent streams; but the greater number are mere mountain torrents, short, but rapid in their courses, and dry in summer.

General Aspect.

The general aspect of Greece is characterized by a very singular distribution of its mountains. These are usually neither placed in parallel chains, nor in massive groups, but are so disposed as to enclose extensive tracts of land, which assume the appearance of large basins or circular hollows. The bottom of these basins consists of an alluvial plain of the richest soil, and level as the ocean; through which sometimes rise steep insulated rocks like the summits of vast natural columns. Nature had thus marked out the country into a number of distinct districts admirably calculated to become the seats of small communities. The plain, with its rich alluvial soil, furnished subsistence for a dense population; the insulated rock became the Acropolis or citadel of the chief town, a place of refuge in war; and the surrounding mountains were barriers against invasion. In proportion as access from without was difficult, internal communication was rapid and easy. A crowded population, dispersed over the sides and the area of this natural amphitheatre, lived, as it were, in the continual presence of one another. Their country,—a word of undefined import in large empires, conveyed to them as distinct an idea as that of their own homes. Its whole landscape, with its trophies, temples, monuments, and fields of renown, were constantly under their eyes. Their patriotism, concentrated within this narrow sphere,—attached to visible objects by early and habitual associations,—kept alive by frequent struggles with neighbouring communities, for independence or glory, and still more by the proud sense of individual importance, inspired by their republican institutions,—was not, as in larger empires, a vague and languid feeling, but an ardent and steady passion, of which nothing in the modern world can give us an adequate idea. The same circumstances had an influence on their political condition. Conquest, which forces nations of different habits, characters, and languages, into combination, is the great parent of slavery. In such heterogeneous masses union becomes impossible. The despot, glittering in barbaric pomp, and surrounded by foreign guards, appears in his subject provinces like a being of another order, not to collect the sentiments, or redress the wrongs of the people, but to silence all complaints, and enforce obedience to his own lordly will. Though hated by all his subjects, he can still employ the wealth and the physical force of one nation to trample on the rights of another, and is thus able to hold the whole in slavery. But the small Greek communities, protected by the barriers of their gulfs and mountains, escaped this evil destiny. The people, united by identity of manners and language, by common interests, and continual communication, could combine with the utmost facility to resist the first encroachments of their rulers. They were able to apply freely the lights of reason to all their common concerns, to model

* Holland, p. 89, 319, 379—394, 401, 416, 461, 516; Clarke, VII. 15—18, 134, 222.

their government according to their circumstances and their views of common interest, and to make the end for which it existed, the measure of the powers bestowed upon it. The forms of government they adopted, though not contrived by absolute wisdom, were probably in principle better adapted to their situation than any other that could have been suggested. And never did the powers of the human mind display themselves with such energy and grandeur under any other system in the history of the human race. (Clarke, III. 97, and VII. 59.)

Of the plains we have mentioned, some terminate in the ocean, and seem to owe their existence to the retiring of the waters. Such are those of Macedonia, Athens, Argos, Laconia, Messenia, and Ambracia. Others are completely surrounded by a rampart of mountains or high grounds, except at a single point where the waters have found or forced a passage. Of this description are the three remarkable vallies of Thessaly, Bœotia, and Arcadia. Each of these forcibly suggest the idea of a vast inland lake, where the waters accumulating for a long period, had at length burst through the barrier that confined them, and left the bottom dry. There is also an analogy between these vallies and some of the inland seas of Greece, such as the Gulfs of Corinth, Arta, Volo, and the Channel of Negropont, which are marine lakes completely land-locked, and communicating with the Mediterranean by a single passage, which may at one period have been closed. It may even be conceived that the Archipelago itself, at one period, was completely shut in by a barrier of high lands, of which Cerigo, Crete, Scarpanto, and Rhodes, are portions or fragments; and that its numerous isles are either the summits of mountains which then diversified its surface, or of detached rocks like those of Meteora in Thessaly, which have resisted the incessant action of the waters.

Topography. The valley of Macedonia, which extends in a semicircle round the head of the Gulf of Salonica, is the largest and most fertile district in Greece. Its produce has been supposed to be nearly equal to that of all the rest of the country. The rivers in the lower parts, which overflow annually, render the country marshy, and subject to the malaria. It contains a considerable number of ancient remains, but they have only been partially examined. A large tumulus still marks the site of the battle of Pydna, which reduced Macedonia to a Roman province. Thessaly, separated from Macedonia by Olympus and the Cambunian mountains, is a vast circular basin, of fifty or sixty miles diameter, enclosed on all sides by mountains, and next in fertility to Macedonia. The whole of its waters flow off by the River Peneus. The celebrated vale of Tempe, a deep ravine, formed by precipitous cliffs, six or eight hundred feet high, and separating Mount Olympus from Ossa, affords a passage for this river to the sea, on the east. The vale is about five miles long, and so narrow, that the river, in some parts, occupies the whole breadth of its bottom: the scenery is more striking by its grandeur than its beauty. The rocks, which are of bluish grey marble, have a shattered appearance, and wherever the surface admits of it, are covered with trees and shrubs. Some of the ancients believed that this defile was formed by an earthquake. Were any natural convulsion to close it up, Thessaly would again be converted into a lake; and Xerxes, when he invaded Greece, threatened the Thessalians with this catastrophe, if they opposed him. The rocks of Meteora, at the upper side of the Thessalian plain, are objects of a very remarkable kind. They rise from the level surface of the country near the Peneus, and cover a triangular space of two miles each way. They consist of a great collection of lofty rocks, in the various shapes of cones, pillars, rhomboids, and irregular masses, all standing detached from one another, with faces generally as perpendicular as a wall. Their height varies from one to three or four hundred feet, and the deep winding intervals between them are filled with trees and brushwood. On the summits of some of these rocks monasteries are suspended in mid air, as it were, on the tops of very tall pillars. Some of the monasteries occupy the whole surface of the rock they rest on, and persons ascending to them are swung in a basket or net, and dragged up by a rope passing over a pulley. The rocks are composed of a conglomerate, consisting of fragments of granite, gneiss, and other primitive substances, disposed in horizontal strata. The narrow district on the eastern side of Mounts Ossa and Pelion is the ancient Magnesia, and is now called Zagora. At the south extremity of Thessaly lies the famed pass of Thermopylæ, which is merely the narrow space between the flank of Mount Œta and the sea. The part of this space nearest the sea is occupied by a marsh; between which and the cliffs the breadth of firm land is still about sixty paces, as stated by Livy. The hot springs mentioned by Herodotus; the remains of the wall built by the Phoceans, and a tumulus, believed with good reason to be that of the Spartans, are all yet to be seen. The length of the pass is about five miles. The country of Phocis, which lies immediately south of the pass, is one of the most rugged in Greece, being occupied almost entirely by the branches and declivities of Mounts Œta, Parnassus, and Helicon. Bœotia is a large circular valley, enclosed by Parnassus on the west, Helicon on the south, Cithæron on the east, and a range of high lands on the north. A low ridge running north and south divides it in two. The lake Copais, which occupies the bottom of the western and larger division, and receives all its rivers, sends off its waters by subterraneous passages to the sea on the north-east. In summer this lake has the appearance of a green meadow covered with reeds. Bœotia has more than once been inundated by obstructions in these subterraneous channels. The country is very fertile; but is higher and colder than Attica. It is often covered with thick fogs, as described by the ancients; and, from the abundance of its marshes, is very subject to malaria. Attica, which adjoins to Bœotia on the east, is comparatively arid and barren, hilly rather than mountainous, but distinguished peculiarly by the dryness and elasticity of its atmosphere, and the beauty and serenity of its climate. The isthmus of Corinth, which connects Attica with the

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Morea, is occupied towards the north by high rocky hills, which render it strong as a military post; but in the south, where its breadth is about four miles, the surface is low, seldom exceeding 150 feet. The remains of the ancient wall, and of the canal begun by Nero, are yet visible. The Morea consists of an elevated central *plateau* or valley, namely, Arcadia,—and of five separate districts, formed by the exterior declivities of the mountains which surround the central *plateau*, and by spurs or branches which run off from these mountains. The central valley of Arcadia, so famed for its pastoral character by the ancients, is like the inland districts of Thessaly and Bœotia, high and cold, often covered with fogs, arising from the moisture of its soil, and hence also subject to malaria. All its waters escape by the single channel of the Alpheus; and it has sometimes suffered from partial inundations. Its scenery, in the opinion of Lord Byron, is by no means deserving of its ancient celebrity. Argolis, lying in a semicircle round the Gulf of Nauplia, embraces but a small portion of level country, which, however, is remarkably rich, but very unhealthy. The city of Argos still exists in its ancient plan, and is one of the best built towns in the Morea. The ancient Laconia, consisting of the long open valley of the Eurotas, is very thinly peopled. The ruins of Sparta, four miles southwest from the village of Mistra, are extensive, but afford no fine specimens of architecture; the spot is entirely deserted. Messenia, which lies round the head of a gulf, has a pretty large plain, of a very rich soil. Elis, on the west, and Achaia, on the north of the Morea, are in general hilly, and rather dry. In general, the west of Greece has a different physical character from the east. Ætolia, Acarnania, and Epirus (the modern Albania), present none of those circular basins so characteristic of the east and south sides of the country, except the valley surrounding the Gulf of Arta. Ætolia and Acarnania consist of long vallies open to the south, and rising into mountains in the north. Albania has the same features on a larger scale. Its mountains, which are more numerous than those of any other district of Greece, cover the country in long parallel ridges, and are separated by deep vallies, some of which open to the south, and others to the west, but none to the north. The Cyclades, and other islands in the Ægean sea, are almost all steep and rocky.*

Scenery.

The mountains of Greece, which cover so large a proportion of its area, are partly wooded and partly naked. The low country susceptible of tillage probably does not amount to more than two-fifths of the whole surface, and of these two-fifths, judging from the corn, olives, cotton, tobacco, &c. required for the population, one-twelfth or fifteenth part may be actually in cultivation. It is generally bare of wood, and, from the want of enclosures, the profusion of weeds and brushwood, the thinness of the population, and the ruinous condition of the few cottages, combined with the crumbling remains of the noble structures of the ancients,—has a desolate, melancholy, and deserted aspect, which harmonizes well with the fallen fortunes of the country. In the end of summer, from the excessive heat which dries up the streams, the hills and fields appear parched. In many quarters of the country, however, there are copious perennial springs, which gush out suddenly from the limestone rock. Greece combines in the highest degree every feature essential to the finest beauties of landscape, except large rivers, which are perhaps incompatible with the general character of its scenery. Travellers of taste have wanted words to describe the magnificence of the views it affords. Its mountains encircled with zones of wood, and capped with snow, though much below the Alps in absolute height, perhaps are as imposing from the suddenness of their elevation. Rich sheltered plains lie at their feet, which want nothing but an industrious population to fill the mind with images of prosperity, tranquillity, and happiness. But it is in the combination of these more common features, with so many spacious and beautiful inland bays and seas, broken by headlands, enclosed by mountains, and specked and studded with islands, in every variety of magnitude, form, and distance, that Greece surpasses every other country in Europe, and perhaps in the world. The effect of such scenery, aided by a serene sky, and delicious climate, on the character of the Greeks, cannot be doubted. "Under the influence of so many sublime objects, the human mind becomes gifted as by inspiration, and is by nature filled with poetical ideas." Greece became the birth-place of taste, science, and eloquence, the chosen sanctuary of the muses, the prototype of all that is graceful, dignified, and grand, in sentiment or action. The poetry of the north, nursed amidst bleak mountains,—amidst oceans covered with fogs, and agitated by storms, is austere and gloomy; but the muses of Greece, awakened into life in a rich and beautiful land, amidst bright and tranquil seas, are gay, joyous, and luxuriant. You almost conceive (says Chateaubriand), as it were by intuition, why the architecture of the Parthenon has such fine proportions, why ancient sculpture is so unaffected, so simple, so tranquil, when you behold the pure sky and delicious scenery of Athens, of Corinth, and of Ionia. In this native land of the muses, nature suggests no wild deviations: she tends, on the contrary, to dispose the mind to the love of the uniform and the harmonious. †

Climate.

The climate of Greece seems to be distinguished from that of Spain and Italy in the corresponding latitudes, chiefly by having the characteristics of an in-

* Beaujour, Let. 1—4; Holland, p. 280, 291, 234, 376, 420; Clarke, VI. 562, VII. 303; Hobhouse, Let. 14, 15, 16; Walpole, 60, 303, 306, 335, 522; Byron's Notes to Canto 2d of *Childe Harold*; Tournefort, Let. 4—8.

† Holland, 248, 302, 401, 254, 518; Hobhouse, 83, 461, 201; Clarke, VII. 260; Beaujour, Let. 4; Chateaubriand's *Travels* (Translation), Vol. I. p. 85, 187; Williams's *Travels*, Let. 54, 55, 68, 72, 74.

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land region in a higher degree; that is, the extremes of summer and winter are more severe. In Attica, which has a drier atmosphere and more uniform temperature than the rest of the country, the average rain is about 21 or 22 inches, and the greatest heat, in each of the four years ending with 1807, was 104, 99, 93, 94. The greatest cold was from 28 to 32 of Fahrenheit. The mean deduced from all these extremes is 63.5. This agrees very nearly with the temperature of a spring in the isthmus of Corinth, observed by Dr Clarke, 64°, and with the mean annual temperature given in Professor Leslie's table, which is 64.4. At the southern extremity the annual temperature, according to the same authority, is 65.3, and at the northern extremity about 60. But local diversities have a greater effect than mere difference of latitude on the distribution of the seasons. In Attica, which being freely exposed to the sea, has in some measure an insular climate, the winter sets in about the beginning of January. About the middle of that month snow falls, but is seldom seen for more than a few days, though it lies for a month on the summits of the mountains. Gentle rains fall about the middle of February, after which spring commences; and the corn, which is a considerable height in March, is cut in May. In the beginning of March, the vines and olives bud, and the almonds are in blossom. In the great interior plains and vallies, which are girt with mountains, and cut off from the direct influence of the sea, the winters are much colder, and the summers, making allowance for the difference of height, are warmer. At Tripolitza, in Arcadia, the snow has been found 18 inches thick in January, with the thermometer at 16° Fahrenheit; and it sometimes lies on the ground six weeks. Dr Clarke was informed, that in the winter preceding his visit, the peasants at the foot of Mount Cithœron in Bœotia were confined to their houses for several weeks by the snow. At Janina, situated in an inland plain, 1000 or 1200 feet above the sea, the snow lies to a considerable depth in the winter, and sometimes falls as late as April. The neighbouring lake was so firmly frozen over in 1813, that it was every where crossed on the ice. The summits of the central chain of Pindus, and most of the Albanian mountains, are covered with snow from the beginning of November to the end of March. These various facts show that the winter in Albania, though shorter than in England, is as severe; but that the summer is a vast deal hotter, the extreme summer temperature being 15 or 18 degrees higher at Athens than London; while Bœotia and Thessaly are probably still hotter than Attica. Though we have no accurate data to establish a comparison between the climate of Greece and those of Spain and Italy, yet the fact of cotton being successfully cultivated, on a large scale, in Macedonia, as far north as the latitude of Rome and Valadolid, where it does not succeed in the two last countries, is a proof that the summer temperature in Greece is higher than either in Spain or Italy. The coldest weather in all parts of Greece is accompanied with a north-east wind. The north and north-west winds are distinguished by their serenity and dryness. The zephyr or west wind is famed for its balmy softness; the south-east, south, and south-west winds are all humid, and the east wind still retains the character of a morning breeze, as described by Aristotle. The sirocco is felt in Greece. It blows from the south-east, and produces its usual effects on the human constitution,—a sense of oppression, a dull headach, with lassitude and uneasiness in the limbs. Earthquakes are very frequent in Greece, but they are seldom very destructive. *

Metals.

Modern travellers afford us but scanty information respecting the mines of Greece; but, from its geological structure, we may conclude that it is like Italy, rather poor in metals. The working of the veins which do exist is neglected by the Turks, from want of skill, or abandoned in consequence of the oppressive exactions of the government. It is chiefly on the east side of Greece, where the older rocks protrude through the superincumbent limestone, that metalliferous veins have been found. The silver mines of Laurium, in Attica, which were extensive enough to employ 10,000 slaves, and supported the Athenian navy at one period, are now entirely abandoned. Copper also was anciently found in Attica. Ores of iron, gold, silver, lead, or alum, were wrought in Eubœa and in Melos, Naxos, Siphnus, and others of the Cyclades. The gold and silver mines of Macedonia yielded Philip 1000 talents a-year. At Nisvoro, in this country, there is still worked a silver mine, which affords a scanty produce of from 50 to 400 okes † of silver, and 4000 or 5000 okes of lead annually. Marbles of many varieties are abundant in Greece. Those of Paros and Mount Pentelicus, which are both highly crystalline, were employed in the finest works of sculpture and architecture. At Selenitza, in North Albania, there is a very extensive mine of asphaltum, or compact mineral pitch. The bed, 70 or 80 feet thick, and near the surface, is supposed to extend over a span of four miles in circumference. Carburetted hydrogen gas issues from several crevices of the ground near it, and inflames spontaneously,—a phenomenon distinctly alluded to by ancient authors, and connected in this and other instances with the superstitions of the Greek mythology. ‡

* Holland, 47, 137, 411, 426; Hobhouse, Let. xxiv.; Pouqueville, p. 29, Chap. xv.; Clarke, VI. 585; VII. 102; Arist. *Meteor.* L. 2. C. 2.

† The *oke* is equal to $2\frac{3}{4}$ pounds avoirdupois; Dr Holland says $2\frac{1}{2}$; but Beaujour, the best authority on this subject, makes the oke equal to 40 Paris ounces, which are equal to 43.3 English ounces. The cantaar or quintal is generally 44 okes=121 pounds. The kilo, or quilot of corn, is 22 okes, or 60 pounds. (Beaujour, Let. xxiv.)

‡ *Travels* of Anacharsis, Eng. edition, 1791, II. 424, V. 34; Holland, 416, 518; Walpole, 228; Clarke VI. 348; VII. 462; Tournefort, Let. iv. v.

Greece. Diseases.

There are few or no diseases peculiar to Greece. Like all the countries on the shores of the Mediterranean, it suffers greatly from malaria. This prevails chiefly in the months of August and September, and produces remittent or intermittent fevers, which attack those who reside in low situations, near the mouths of rivers, or in the neighbourhood of lakes, marshes, or rice grounds. The ancients were aware, that fevers of this description affected certain districts; but, undoubtedly, the sphere of their influence has been vastly extended by the neglected state of the country. Attica, though one of the driest districts of Greece, is not entirely exempted from them. These fevers, recurring frequently, vitiate the system, and produce goitres and scrofulous complaints. Coughs, catarrhs, and apoplexies, are prevalent in some districts; and elephantiasis, and leprous affections, arising probably from deficient and unwholesome nourishment, are more common than in other countries. The plague occurs at irregular periods, and makes great ravages, but is generally believed to be imported from Constantinople, Smyrna, or Egypt. The first appearance of this dreadful scourge spreads alarm and terror through the whole community. The affrighted imaginations of the people represent to them nocturnal concerts of music, voices murmuring amidst the silence of night, spectres wandering about on the roofs of houses, covered with funereal rags, and calling out the names of those who are to be cut off from the number of the living.*

Agriculture.

A rapacious and tyrannical government, like the Turkish, depresses every species of industry, but is particularly fatal to agriculture, which requires the investment of large capitals, with the prospect of only distant returns, and which yields products that cannot be concealed. The Turkish landlords and farmers are too sluggish and ignorant to attempt the smallest improvement; the other classes are too much exposed to pillage; and all must be affected by the insecure tenure of their lands. In Greece, as in other parts of Turkey, all lands hold immediately of the Sultan, and on the demise of the incumbent, vest anew in him. When the Turks conquered the territories they now occupy, the lands were taken from the native proprietors, and a part of them distributed among Turkish colonists in *Zaims* and *Timars*† (the one exceeding 500 acres in extent, the other from 300 to 500); on condition that the possessors, with a stipulated number of followers, should serve in the armies during war. Any of these properties which fell vacant during active service was bestowed upon the volunteers who had signalized their valour in the hope of obtaining such rewards; and there are instances of the same lordship having been eight times disposed of in the course of one campaign. Another part of the land was appropriated for the support of mosques, or as appanages to the great officers of state, the mother and mistresses of the sultan, and the children of the imperial family. The residue, burdened with a territorial impost or land-tax, was left, by an undefined tenure, to the ancient inhabitants. (Thornton, 164.) In general, both Greeks and Turks pay a quit rent to the Aga or local governor, besides the land-tax of one-tenth to the sultan. We do not find it any where stated what proportions these different species of property bear to one another; but it is obvious that a great part of the land is held by persons who have but a liferent interest in it; and though custom may temper a rule so pernicious, and the right of resumption may not be rigorously exercised at the demise of each incumbent, it will still be made a ground for vexatious demands, and render the transmission of property dependant on the caprices of provincial governors. To this must be added the farther insecurity arising from bad laws badly administered; from the extortions practised by every class of public functionaries, civil and religious; and, last of all, from the depredations of bands of robbers, who descend from the mountains, sometimes in parties of five or six hundred, to dispute with the local rulers the right of plundering the unhappy husbandman. Ali, the Pacha of Albania, permits no sale or transfer of lands within his dominions, without his special consent. He holds great quantities of land himself; and, not content with buying it from those who are disposed to sell, he compels others, by quartering soldiers on them, and harassing them by vexatious demands, to part with their lands for an inadequate price. He is now believed to be the proprietor of one-third of the whole cultivated country under his government. In such circumstances, it need not surprise us that cultivation is badly conducted, the peasants poor and wretched, and the country a wide waste, affording a miserable subsistence to two millions and a half of inhabitants, where three or four times as many lived in comfort and prosperity in the days of Xenophon.‡

Corn.

The most considerable proprietors, both Turks and Greeks, live generally in towns, and the land is let to the peasants on a system resembling that of the metayers in France. The lands are let from year to year; the landlord furnishes cottages, cattle, and seed; the tenant labours the ground; and after a tenth of the produce is set aside for the public tax, the remainder is divided into three parts, of which the tenant gets one and the proprietor two. When the tenant has cattle and a house of his own, he gets one-half. In the chiflicks or farms belonging to Ali, who is a rigorous landlord, two-thirds are taken when the peasant finds stock and seed.

* Pouqueville, Chap. xvi.; Clarke, VII. 470; Walpole, p. 13.

† The number of these feudal lordships is variously stated. Olivier says there are 914 *zaims*, and 8356 *timars*, in European Turkey. If these are estimated at 500 acres each, they will not amount to more than 1-20th or 1-25th of the whole lands, including mountains.

‡ Thornton, Chap. iii. v.; Beaujour, I. p. 3; *Travels in Sicily, Greece, and Albania*, by the Rev. T. H. Hughes. 1820. p. 82.

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and five-sixths, it is said, when he furnishes nothing but labour. Enclosures are extremely uncommon, and scattered hamlets or cottages are scarcely any where seen, the peasants living in villages for the sake of security. Both the husbandman and shepherd, when employed in the fields, has always a musket slung over his back, besides a pistol and sword at his side. Their cottages are hovels built of mud, straw, and boards, generally without an opening to let the smoke escape. Sometimes they are without walls, and consist merely of wooden poles laid together in the form of a tent, and covered with turf, like the huts of savages. Women are employed in the labours of the field in Albania and Maina, but rarely in other parts. The cultivation of corn land is generally rude and slovenly; but in some districts, where, from local circumstances, the people are well protected, it is neat and clean, though not skilful. Cotton and olive grounds and vineyards, which are laboured chiefly with the hands, are managed with more care; and in general, that part of the cultivation which depends on manual labour, and requires neither capital nor good implements, is best executed. The management of sheep and goats is also better conducted than that of arable land, doubtless because store farms are generally in situations more capable of defence, and their stock is easily removed. In gardening, the Greeks turn up the soil with a mattock, being unacquainted with so common an instrument as a spade. The implements of agriculture are few and simple. In light lands like those of Messenia, the plough consists merely of a share pointed with iron, without any other parts attached to it. It is dragged by one horse or two asses. In stronger soils the share is fixed into a plough with one handle and two mould boards, and in some cases with block wheels. In Albania the plough consists of a pole, a share, and one handle, all of wood, except the share, which is pointed with iron. In Bœotia, Thessaly, and Albania, and in Greece generally, the plough is drawn by two oxen, sometimes by asses or buffaloes, very seldom by horses. A hundred stremata of land require four oxen if the soil is light, or eight oxen if heavy. The strema is stated to be forty square paces; if yards are meant, it will be very nearly one-third of an acre. The corn, cut with a sickle, is separated from the straw in the ancient mode, by treading it under the feet of oxen or horses. Fallowing is practised, and manures are used, though the small quantity of ground in tillage will, of course, render it unnecessary to cultivate poor soils, which require much artificial nourishment. In some few parts of Macedonia and Thessaly, a sort of clumsy car with solid wooden wheels is used, but every where else wheel-carriages seem to be unknown, produce and goods of all kinds being carried on the backs of horses, mules, or camels.

The most common crops are wheat, barley, maize, and rye; besides these, oats in very small quantity, rice in marshy spots, millet, pease, beans, tares, sesamum, and anise, with cotton and tobacco. Turnips, if raised at all, are confined to gardens, and potatoes seem to be entirely unknown. The corn, sown in November or February, is high in the beginning of March, and is cut in May. It is sometimes sown as late as April, and reaped in two months. After a crop of barley, cotton is sometimes sown and reaped the same season. The soil of Attica is too light for wheat; and hence barley, as in ancient times, is still the prevailing crop. In the Ionian isles, and probably in the moister parts of Greece, wheat is protected from the effects of heavy dews, by two persons dragging a long rope over the field, so as to shake the husks. In the rich soils of Macedon, to save the wheat from being injured by superabundant nourishment, it is usual to let it be eaten by sheep early in the season, a practice familiar to the ancient Greeks. Notwithstanding the wretched system of culture, the produce is large. The most fertile parts are the plains of Thessaly, Bœotia, Sicyon, Argos, Messenia, Arcadia, and Macedonia. The soil of the latter, in the opinion of Beaujour, is superior even to that of Sicily. An arpent * of this soil usually produces from 25 to 30 quintals (hundred weights) of wheat. In the Arcadian plains wheat of several kinds yields 12 for 1; in those of Argos 10 for 1; in Eleusis, the primitive seat of agriculture, and in Thessaly, 12 for 1. The produce of good soils, generally in favourable seasons, is estimated by Mr Hawkins at 10 or 12 for 1; and of the best soils, in very favourable seasons, at from 15 to 18 for 1. If these estimates are well founded, considering the rude system of cultivation, they are proofs of a very great degree of fertility. In England, the average return from the seed, notwithstanding its highly improved agriculture, is believed not to exceed 9 for 1. The very best soils yield from 6 to 7 quarters of wheat *per* acre, weighing from 24 to 28 hundred weight; but from ordinary soils, the average produce *per* acre is only about 20 or 21 bushels, weighing from 10 to 11 hundred weight. Greece exports corn largely, both to Constantinople and the western parts of Europe.†

Pasture.

Greece, abounding in mountains covered with herbage, is eminently a pastoral country; and the management of sheep is better understood than the other branches of rural economy. The modern breeds, however, have declined much from the ancient in beauty and value. The flesh is but indifferent, the wool of inferior quality, and the weight of the sheep is only from 30 to 50 pounds. The flocks of Arcadia and Livadia, especially those which feed upon Parnassus, are considered superior to the others. A black-woolled breed is very common. In Greece, as in Spain, the flocks migrate from the

* An arpent is nearly equal to $1\frac{1}{4}$ English acre. (Mentelle et Malte Brun, *Metrol.* Tab. 14.)

† Beaujour, Let. i.—v.; Pouqueville, p. 45, Chap. xvii.; Walpole, p. 60, 290, 226, 150, 146; Holland, 36, 504, 248, 482; Hobhouse, p. 138, 135, 227, 354; Eton's *Survey*, p. 220; Williams, II. p. 354, 411; Clarke, VI. 546, VII. 339; Hughes, II. 81; Wheler (Ed. 1682), p. 330; *Travels* of Anach. Chap. lix.

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inland mountains to the low valleys, near the sea, at the approach of winter. Attended by the owners, with their servants, they come down, in October, in vast numbers to the low country, where they enjoy the right of pasture under the laws or customs of the empire, and they return to the hills in April. The goats, which are also numerous, are shorn along with the sheep, and their hair is made into sacks, bags, and carpets. The flocks are guarded from the wolves by very large and strong dogs, supposed to be descended from the ancient Molossian breed. Attica, which forms only the fiftieth part of Greece, has been stated to possess 100,000 goats, and 60,000 sheep, about one-tenth part of which are killed yearly. And yet it is not so much a pastoral country as Albania, Phocis, or Arcadia. The oxen, which are chiefly used for labouring, amount to about 3000 in Attica: the cows, principally kept for breeding, are rather less numerous. The oxen of the Morea are low in stature, have long white hair, and weigh from 300 to 400 pounds. The cows there give little milk, and are exposed to jackalls, which tear away the teats, and to serpents, which are said to suck the milk. About 6000 head of cattle are consumed annually in the Morea; but as both Turks and Greeks prefer mutton, the number of sheep killed is incomparably greater. A very fine breed of oxen is found in that district of Albania which corresponds to the ancient Chaonia, and which has probably derived its beauty from the ancient breed of the country, celebrated by Aristotle, Ælian, and others. In all parts of the Morea, buffaloes, which are handsome animals, with fine skins, are used in husbandry, and when unfit for labour, are killed and eaten. The horses of the Morea are little to be admired for their beauty, but are active, vigorous, and sure footed. The asses, which are numerous, but small and mean, are used as beasts of burden; mules and camels are employed in the same capacity, but the latter are brought from Asia, and are not numerous. The annual produce of Macedonia, in wool, is estimated by Beaujour at 700,000 okes (2,000,000 pounds), of the Morea, by Pouqueville, at 12,800 quintals (1,500,000 pounds): and it sells about 15 piastres * (18s. 9d.) the quintal. The Morea produces annually about 66,500 quintals of cheese (chiefly from the milk of sheep and goats), which sells at 7 piastres the quintal, or about one penny *per* pound. In Attica, a good cow is worth 12 piastres; a good ox, fit for the plough, 50 or 60 piastres; a horse for carrying burdens, 50 to 65; a mule for riding, 150 to 200. A sheep sells at 3 piastres; a lamb at $1\frac{1}{2}$; a goat at $2\frac{1}{2}$, or 100 paras. Wheat fluctuates much in price, but has been stated to be on an average $5\frac{1}{2}$ piastres (6s. 10d.) the kilo † or bushel. ‡

Cotton.

Cotton is cultivated from one extremity of Greece to the other, but on the greatest scale in the district of Seres in Macedonia, a rich and populous plain watered by the ancient Strymon, and containing 300 villages, so near one another as to present the appearance of one large straggling town. It is a more profitable, but more precarious crop than corn; requiring clear sunshine, copious dews, and light rains, to make it succeed. An arpent of good soil produces from 200 to 300 okes (550 to 825 libs.) of cotton, which, valued at a piastre the oke, is worth from 200 to 300 piastres. But the price varies from $\frac{2}{3}$ to $1\frac{1}{3}$ piastres. The plain of Seres alone produces 70,000 bales, or seven millions of okes of cotton, of which 50,000 bales are exported. Considerable quantities are also raised in the ancient Chalcidice (another district of Macedonia), in Thessaly, Bœotia, and the Morea. The annual produce of the last, according to Pouqueville, is only 59,000 okes, exclusive of two cargoes exported. §

Tobacco.

Tobacco, though introduced into Turkey only about the middle of the seventeenth century, is now a luxury in universal use. It is cultivated on a very narrow scale in the south of Greece, but to a considerable extent in Albania and Macedonia, and of a quality much esteemed. The Turkish plant is not,

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* The piastre is equal to 40 paras, and the para is equal to 3 aspres.

The value of the piastre, from the progressive debasement of the Turkish coin, has been continually sinking; and it is besides liable to fluctuations from variations in the rate of exchange. Dr Chandler, in his time (1764), reckoned the piastre worth 2s. 6d. English. Beaujour says, that in his time (1787 to 1797), its intrinsic value was 28 sous (1s. 2d.), but its value in exchange was, on an average, about 37 sous (1s. $6\frac{1}{2}$d.) Dr Clarke (1800) represents it as worth 1s. 4d. Mr Hobhouse (1809) says, that when the exchange is at par, $17\frac{1}{2}$ piastres are equal to one pound, which gives 1s. $1\frac{3}{4}$d. for its value. Dr Holland (1812) generally reckons the piastre about 1s. 1d.; and Mr Williams (1817) makes it worth no more than 8d. in exchange. In the calculations in this article, the piastres are generally turned into English money, at the value assigned to them by the author from whom the facts are taken, and when the facts are derived from various authors, 1s. 3d. is taken as the mean value.

† According to Beaujour (Let. xxiv.), $1\frac{1}{2}$ septiers = $4\frac{1}{2}$ kilos of Constantinople; and one quarter being equal to 1.83 septiers, should be equal to 6.76 kilos. The kilo, therefore, is to the Winchester bushel as 20 to 17; but, judging by the weight, the kilo (22 okes or 60 lbs.) should be very nearly the same as the wheat bushel, which weighs from 56 to 64 pounds; and Dr Sibthorpe reckons $8\frac{1}{2}$ kilos equal to a quarter. (Walpole, 145.) It is probable the provincial measures are not very consistent with one another; but the latter calculation appears the more accurate, and we may, therefore, with great propriety, reckon the kilo equal to the bushel.

‡ Beaujour, Let. v.; Pouqueville, 200, 462; *Travels* of Anacharsis, Chap. lix.; Holland, 326; Walpole, 141-4, 226, 193.

§ Beaujour, Let. ii.; Pouqueville, 462; Holland, 227, 248.

Greece. however, so pungent as that of America, and latterly the produce seems to be diminishing. The quantity annually raised in Macedonia was estimated by Beaujour (between 1787 and 1797) at 100,000 bales, or 10,000,000 okes, valued at 4,000,000 piastres. It occupied about one-eighth of the cultivated soil, and afforded support to 20,000 Turkish families. One half of the quantity raised was exported to Egypt, Barbary, and Italy. In 1812, the annual produce, as stated to Dr Holland, was only from 35,000 to 40,000 bales. (Beaujour, Let. iii.; Holland, 329; Hobhouse, 15.)

Olives. The olive is cultivated throughout Greece generally, but that of Attica is still distinguished as in ancient times by its superior excellence. It requires a dry soil, a sheltered situation, and a warm exposure; and is therefore not adapted to the rich, moist plains of Bœotia and Thessaly. The tree gives fruit the twelfth year, arrives at full vigour about the twentieth, and, when not exposed to frost, is so durable, that the present olives of Palestine are believed to date from the Crusades. An arpent of ordinary olive ground will nourish 120 trees, each of which yields in good years 20, but in average years 10 French pounds * of oil, and as this sells at 6 or 8 paras the pound, the whole value of the produce is about L. 12 Sterling. Attica yields annually of this oil 2,400,000 pounds, of which three-fourths are exported. It is at present, as it was in ancient times, the staple produce of the country; the tree was indeed considered as a special gift from the gods; and its cultivation was favoured by peculiar protection and encouragement, as far back as the reign of Cecrops. The Morea, according to Pouqueville, yields 5,570,000 pounds of oil. The amount of the produce of Albania and other districts is not known. If the opinion of the ancients is well founded, that the olive does not thrive at a great distance from the sea, it may be presumed that the plantations in the interior of the country are less numerous than on the coast. †

Vines. Vines are cultivated on a small scale in Attica, Albania, Thessaly, and in most of the districts of Greece, but without the skill and refinement which the ancients had introduced into this branch of rural economy. Dr Clarke, however, observed some vineyards on Parnassus, which were managed with much care and neatness, and afforded excellent wines. In general, the Greek wine, owing to the resin and lime mixed with it, has an unpalatable harshness. Pouqueville estimates the produce of the Morea, in wine and brandy, at 32,300 barrels, of 50 okes each, or about 550,000 gallons. If the vineyards are not more extensive in other quarters, the whole produce of the country must be inconsiderable. ‡

Currants. The species of grape called the Corinthian grape, or the currants of commerce, is almost peculiar to the Morea and the Ionian isles, though believed not to be indigenous in these countries. It is found in the greatest perfection along the southern shores of the Corinthian Gulf, on some points of the opposite coast, and in Cephalonia, Ithaca, and Zante. Beaujour thinks it was brought from Naxos about 1580; and it must therefore have been unknown to the ancients on the continent. It succeeds best in plains near the sea, with a western exposure, and prefers a dry light strong soil. The mean annual produce of the Morea is estimated at 10,000,000 pounds, of which 8,000,000 are exported to the western parts of Europe, chiefly to Britain. They are sold at 80 piastres the thousand pounds, including duties and expences, which add 60 or 70 *per cent.* to the first cost. Patrass is the centre of this trade. (Beaujour, Let. viii.)

Madder. Madder grows wild in abundance, but is an object of cultivation in the moist plains of Bœotia, where 1200 sacks (of 275 lbs. each) are raised, of which 700 are consumed in Greece in dyeing spun cotton, and the other 500 are exported. The produce of vermilion from the Kermes insect is considerable. The canton of Livadia furnishes 6000 okes, and the Morea 22,000 okes, valued from 6 to 8 piastres the oke. A part is exported. §

Silk. The mulberry tree is becoming an object of increasing importance in Greece, and the produce of silk is considerable. The districts that take the lead in this branch of industry are Elis, Thessaly, and Magnesia, now Zagora. It is chiefly conducted by the women. The annual produce of the Morea in silk is about 79,000 okes; that of Zagora 25,000 okes; which sells at 15 or 18 piastres the oke. A part of the silk of Thessaly is sent across the mountains to Albania. ||

Honey. The management of bees is an object of considerable attention. This branch of industry is even so far favoured by the Turks, that hives, under a regulation of Soliman II. are not seizable in payment of taxes. Honey is abundant in every part of Greece and Albania, but that of Mount Hymettus still maintains its ancient pre-eminence. It is remarkably transparent, and, in the opinion of Beaujour, is superior to the best honey in France. There are about 3000 hives on this mountain, and 12,000 in the whole of Attica, which yield 360,000 pounds of honey, and 24,000 pounds of wax. About one-tenth is consumed within the country; the rest is exported. The honey sells at 8 or 10 paras the pound; the wax at a piastre. The produce of the Morea in honey, judging from Pouqueville's table, does not much exceed one-half of that of Attica. ¶

Fruit Trees. The fruit trees which grow in the fields or gardens of Greece, besides the vine and the olive, are the almond, pomegranate, orange, lemon, citron, banana, fig, with the peach, apricot, quince, plum, and others

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* The French pound is to the English pound avoirdupois as 100 to 92.

† Beaujour, Let. vii.; Pouqueville, 462; *Trav.* of Anach. Chap. lix.; Theophr. *Hist. Plant.* VI.

‡ Clarke, VII. 254; Holland, 212; Hobhouse, 91; Pouqueville, 462; *Trav.* of Anach. Chap. lix.

§ Beaujour, Let. ix. x; Pouqueville, 462.

|| Beaujour, Let. xi; Pouqueville, 200. 462; Holland, 245.

¶ Beaujour, Let. vi.; Pouqueville, 203, 462; Holland, 510.

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of a more common kind. The date grows, but does not bear fruit. The process of caprification, or exposing the fig to be punctured by insects, which is minutely described by Pliny, is still in use, and is thought to improve the fruit greatly. The gardening of the Greeks is badly conducted, and many of their fruits want the rich flavour, which might be given them by the art of engrafting. Their melons, water melons, and gourds, are excellent, and form a considerable part of the subsistence of the inhabitants. Their culinary vegetables, of which they have no great variety, are spinage, artichokes, cabbages, cauliflowers, carrots, beans, lettuce, celery. The forests produce the oak, kermes-oak, cork-tree, pine, larch, ash, plane, aloe, wild olive, the sweet chesnut, whose fruit is the temporary food of the people in many parts, the *Fraxinus ornus*, or ash which yields manna, the turpentine pine, various trees and plants which yield dyes; and a vast variety of flowers and aromatics. *

Wild Animals.

The wild animals of Greece are, the bear, wolf, lynx, wild cat, wild boar, stag, roebuck, wild goat, badger, martin, fox, hare, jackall, weasel, and hedgehog. The bears are rarely seen; but the wolves are numerous; and to guard the flocks and cattle from their ravages, great numbers of dogs, of a powerful and fierce breed, are kept all over the country. The peasant who kills a wolf is rewarded, not as in the time of Solon, out of the public funds, but by a small voluntary contribution. Hares are very abundant; but they are not much hunted except by the Greeks. The method of *calling* hares, or causing them approach the hunter by a particular cry, and then shooting them, is practised.

Of birds, there are very large vultures, various species of falcons and owls, the cuckoo, roller, king's fisher, ducks of several kinds, the domestic goose and turkey, the stork, which arrives at Athens in March and departs in August, partridges numerous, wild pigeons, quails, snipes, teal, blackbirds, the goldfinch, nightingale, the beccafica, a very small bird, the swallow, martin, &c.

The seas, lakes, and rivers, abound with a variety of fish, and the phoca is found on the coast. †

Arts and Manufactures.

The mechanic arts are necessarily in a rude state in Greece, though the vices of the government do not operate so injuriously upon them as upon agriculture. Numbers and union give a certain degree of security to the artizans of towns, which the rural inhabitants cannot possess. But, on the other hand, these arts can only flourish when they are bottomed on knowledge generally diffused; and when entirely separated from scientific principles, they unavoidably degenerate into empirical processes, which are continued by servile imitation. Accidental circumstances may improve some, and prevent others from retrograding; but they are not so connected as to advance equally, or carry forward each other. This is obviously the case in Greece. Some of the ruder mechanic arts have been created or preserved by the indispensable wants of society; others have been imported to minister to the luxury of the great; and a few seem to be fragments saved from the wreck of former knowledge. Hence trades and professions, equally necessary, are exercised with very different degrees of skill, and seem to belong to different stages of social life. On the other hand, travellers sometimes mislead us, by not sufficiently attending to the fact, that the household-furniture of the Turks or Greeks, and the implements and accommodations required for every situation and employment, are few and simple, compared with ours. Works, however, are executed requiring much more skill than many others, the want of which is sometimes referred to as a mark of barbarism. The agents of the British ambassador could not procure a wheeled cart or a ladder in Athens; but it ought to be recollected, that the Greeks, who inhabit a mountainous country, with steep unpaved roads, have some reason for employing pack-horses instead of wheel-carriages, as we did in Scotland sixty or seventy years ago; and if the tradesmen who construct the mosques, the baths, and the palaces of the pachas, would not, or could not make a cart or a ladder, it was certainly not from want of skill, but want of practice.

It would be absurd to compare the manufactures and mechanic arts of Greece with those of England or France; but they are probably little, if at all inferior to those of Hungary or Poland. In the villages and small towns, carpenters use no other instruments than a saw, a hammer, and a hatchet; and it is only in large cities that gouges and chisels, for making mortices, are employed. Artists, however, and tradesmen, are found capable of constructing water and wind-mills, and building bridges. The churches and mosques are often substantially built and well finished, though designed in bad taste. The palaces of the pachas are generally executed in a very sumptuous style: they are beautifully wainscotted, have marble floors sometimes inlaid, are adorned with good carved work and gilding, with paintings not at all despicable, and with various decorations, which would be thought handsome even in the west of Europe. The baths, fountains, and sepulchral monuments, also display some good architecture. In some few cases, it is probable these works are executed by foreign artists. Ships of considerable burden are built at Hydra and Spechia. There are goldsmiths among the Greeks and Turks, who can combine the metals, and execute devices neatly enough upon sword-belts and scabbards, though their workmanship is inferior, in taste of design and delicacy of execution, to that of English and French artists. Knives and forks are made at Athens; daggers, and other articles of armoury, at Mistra. Good pottery, resembling the ancient in purity, brightness, and elegance, is made at Larissa. The saddles, bridles, and housings of the Turks, are

* Pouqueville, Chap. xvii.; Hobhouse, 69, 227. For an account of the plants of Greece, see a Paper by Dr Sibthorpe in Walpole's *Memoirs relating to European and Asiatic Turkey*, p. 235.

† Walpole, 73—77; Chandler, 126; Pouqueville, Chap. xvii.

well made, according to their fashion, and elegantly embroidered. The Greeks paint in fresco, by a peculiar process, and are possessed of a method of painting in wax, and fixing the colours with heat, which has been thought to be substantially the same with the ancient encaustic painting. The fabrication of images of saints is a considerable branch of manufacture. They are formed mechanically from a model or prototype, which is handed down from father to son; and hence the remarkable uniformity of feature in these images. The Greeks of Janina, and other places, embroider well on stuffs of various kinds; and the artizans of Larissa, Janina, and Salonica, have long excelled in the preparation of Turkey leather. Soap is made at Tripolotza; the art of dyeing is practised in many places with much skill; and in particular, the secret of giving a fast red colour to cotton was long confined to the Greeks of Thessaly, though now known both in France and England. The cloth manufactures of Greece are chiefly of a coarse kind for home consumption; but they embrace also some articles of a finer description for exportation. A silken robe, of very delicate net-work, made in Greece, is believed by Beaujour to be the same sort of fabric as the ancient *gauze of Cos*, or *cloth of air*, except that the latter was made of linen. Ten thousand of these are annually exported from Salonica to other parts of Turkey. Shawls for turbans, serges, velvets, satins, and various silk and cotton stuffs, are made at Tornavos, in Thessaly, at Tripolitza, in the Morea, or other places. The carpets of Salonica, though inferior to those of Smyrna in brilliance of colour, are equal in quality, and are much esteemed in the west of Europe. Of woollens, the principal manufactures consist of coarse fabrics, called *abats*, used for clothing by the peasantry, and of carpets or cloaks; an article in universal use among the Albanians, and also in great demand among the mariners of the Levant. These are chiefly made by the Wallachians, and other inhabitants of the mountainous parts of Albania, Thessaly, and Macedonia. But the species of manufacture which probably employs the greatest number of hands, is the spinning and dyeing of cotton yarn. In Thessaly and Macedonia, 20,000 bales, or 5,500,000 pounds of cotton, are spun annually. The large village of Ampelakia, which overhangs the defile of Tempe, containing 4000 inhabitants, is entirely supported by this manufacture; and it forms the most considerable branch of industry in Tornavos, Larissa, Pharsalus, and in all the villages on the declivities of Ossa and Pelion. Of the yarn, a large proportion is sent to Germany. In general, the manufactures of Greece are carried on by mere manual labour, without combination, and without the aid of machinery; and, considering the disadvantages they labour under from these circumstances, it is rather matter of surprise that they are so extensive. The most industrious provinces are Thessaly, Macedonia, Albania, the Morea, Attica, and Livadia. The western part of Bœotia, with Phocis, Locris, Ætolia, and Acarnania, are totally destitute of manufactures.*

Physic is practised partly by Greeks who have received some education in Italy, and partly by Italians. Many of them, however, have received no education at all, but are adventurers, who, having failed in trade, put on the Frank habit, which all the physicians wear, and commence practitioners. With a few exceptions, they are extremely ignorant and prejudiced; and their practice is limited to the use of bleeding, and a very few remedies: if the disease does not yield to these, the papas is called in, and recourse is had to exorcism. Surgery is chiefly in the hands of the Albanians, who have skill enough to reduce fractures and dislocations, but never attempt amputations, or other operations of any difficulty.†

Commerce.

Greece, deeply indented on three sides by arms of the sea, encircled by numerous islands, and having its inland communications obstructed by mountains, has a natural tendency to become a commercial country; and, from various causes, its foreign trade has suffered less from the wretched policy of its government than either its agriculture or manufactures. The foreign merchant always assumes, in a certain degree, the character of a citizen of the world: Having his capital scattered over many countries, only a small part is within the grasp of tyrannical rulers at one spot; and, when oppressed or disturbed, he can, with greater ease than any other person, transfer his wealth and industry to some other place where they will be more secure. Originally, the commerce of Greece was carried on almost entirely by foreigners, whom the Turkish government found itself compelled to treat with some degree of respect; and the Greeks, who have latterly engaged in it, partly by procuring protections from foreign powers, and partly from the force of custom, have insensibly acquired a share of the consideration and the privileges enjoyed by the class to which they belong. What contributes perhaps still more to their security is, that they are exempted from any immediate collision of interest with the Turks, who, from the aversion to foreigners, arising out of their religious bigotry, almost entirely abandon commercial pursuits. The only exception to this is, that the Beys and Pachas, with the usual short-sighted cupidity of despotic power, have monopolised in many cases the sale of the most considerable articles of export, such as corn and oil (Holland, 84, 328), and they have of course greatly cramped the growth of these branches of trade. The Greeks are gifted in a peculiar degree with the practical sagacity and address required for conducting mercantile transactions; and finding the paths to distinction, and the pursuit of national objects, closed against them, their activity and enterprise flow more abundantly into the channel of commerce. The ruin brought upon many foreign

* Beaujour, Let. i. ii. xiv. xv. xvi.; Thornton, 16—28; Clarke, VI. 273, 280; VII. 344; Hobhouse, 75, 69; Eton, 232; Holland, 123, 133, 265, 288; Pouqueville, Chap. xvii.

† Pouqueville, 194; Hobhouse, 535; Holland, 164.

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houses engaged in the trade of Greece, by the fluctuations and revolutions in the west of Europe, during the last thirty years, has thrown a great portion of it into the hands of the Greeks themselves. (Pouqueville, 207.) And the annihilation of the commerce of France, Spain, and Italy, for a long period, by the ascendancy of the British marine, gave the Greek traders a new and extraordinary importance as neutrals. At present there are individual houses of this nation who have branches established in three or four of the chief commercial towns of Europe, and their ships make voyages as far as America. Within this period, too, the small barren rocks of Hydra and Spechia, off the coast of Argolis, have become the seats of an extensive and flourishing commerce, and have risen suddenly to extraordinary wealth. In 1812, the former had 25,000 inhabitants, entirely supported by trade, with about three hundred trading vessels, some of them as large as 500 tons. * The larger vessels are generally built at Fiume. Funds are supplied for fitting them out by capitalists residing in the island, who have acquired fortunes in trade, and lend out their money at 10, 15, or 20 *per cent.* The captain is generally a principal owner, and every person on board, down to the cabin boy, has a share in the speculation. (Holland, 424.) The Hydriotes have purchased the right of electing their own magistrates from the Porte, and they some years ago expended ten thousand pounds in building their town-house. (Hobhouse, p. 599.) Spechia approaches to Hydra in commercial importance, and there are one or two other small islands which have acquired consideration by their trade. The same cause which raised these places to consequence, created a new trade of a very singular kind at the port of Salonica. Colonial goods, when the usual channels by which they were admitted to the continent were closed in 1810, 1811, and 1812, were sent to Salonica by sea, and thence forwarded overland to Vienna, by a route of 700 miles in length. The goods were transported on horseback; the journey generally occupied thirty-five days, and the expence was supposed to add about 100 *per cent.* to the import price of the articles at Salonica. In 1812, thirty cargoes came direct from England to Salonica, besides a still greater number from Malta and Gibraltar, and cavalcades of a thousand horses sometimes set out at once for Germany. (Holland, p. 323.) This trade would of course cease with the war; but the capital it has created, and the stimulus it has given to the industry of Greece, will lead to new enterprises. The Greeks have in fact a large field for exertion. They conduct not only the commerce of their own country, but that of nearly the whole Turkish empire, except what is in the hands of foreigners. Their vessels are found trading in Egypt, Syria, Asia Minor, the Black Sea, and the Sea of Marmora; and a vast number of small craft ply among the islands of the Archipelago, and between these islands and the continent. When we advert to these circumstances, the information received by Mr Hobhouse in 1809, that the number of Greek mariners altogether amounted to 50,000 (Hobhouse, p. 299, 600), will not appear greatly exaggerated. To form an adequate idea of this subject, we must take into view that the number mentioned amounts to one-third of the number of men in the commercial navy of Great Britain and Ireland in 1817, and to four-fifths of that of the United States in 1808. But as the Greek vessels are generally small, and employ a very great number of hands, the amount of tonnage must be comparatively small.

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The commerce of Greece with the other parts of the world is chiefly carried on by sea; but with Germany, a considerable traffic is maintained by land. The town of Salonica, which is situated in the centre of the most fertile, populous, and industrious districts, Macedonia and Thessaly, is the principal seat of this commerce. As a trading city it rivals Smyrna, and is probably inferior only to the capital. The other most considerable ports in Greece are Orphano, at the head of the Gulf of Contessa, Volo in Thessaly, Athens, Nauplia in Argolis, Calamatte, Coron, and Patrass in the south and west sides of the Morea, Salona on the north side of the Corinthian Gulf, Arta, Butrinto, Avlona, and Durazzo in Albania. The exports, which consist principally of raw produce, are corn, cotton, tobacco, olive oil, timber, wool, silk, honey, currants, figs, hides, dye-stuffs, drugs, with some wine, cheese, butter, live cattle, spun and dyed cotton, some capots or cloaks, carpets, coarse woollens, and a few slight fabrics of silk and cotton. The manufactured articles go chiefly to the other provinces of Turkey. The imports from western Europe consist of manufactured goods, colonial produce and peltry; those from other parts of Turkey, of coffee, flax, timber, rice, drugs, and some manufactured articles; those from Barbary, bonnets and slaves. Both imports and exports pay a duty of 3 *per cent.* if the merchant is a foreigner; but by a strange inversion of ordinary rules, the duty is from 5 to 10 *per cent.* if he is a native. The goods imported are circulated through the country by fairs held in the great towns, and are transported from place to place on the backs of horses, mules, and sometimes camels. The prices are of course greatly enhanced by the risks attending carriage, and by the high rate of interest paid on capital, which is generally 12 *per cent.* in commercial transactions, and 20 *per cent.* in other cases. (Beaujour, Let. xxiii. xxiv.; Holland, 227, 326.)

In the ten years from 1787 to 1797, about one-half of the foreign trade of Greece was with Germany. It was chiefly conducted by Greeks, and Vienna and Salonica were the principal entrepots. The Germans take cotton, raw and spun, from Greece, and return light woollens, linens, muslins,

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* Holland, 424; Mr Hobhouse, who travelled in 1809, says, that Hydra could furnish men for 80 vessels of 300 tons, Spechia for 60 (p. 600); with a small allowance for increase in the intervening period, perhaps the two statements are not inconsistent.

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glass, cutlery, &c. to the value of one-third of their imports, and the other two-thirds in specie. The Italian commerce, which is next in importance to the German, is carried on chiefly with the ports of Leghorn and Venice. It supplied Greece with fire-arms, glass, paper, silks, &c.; Russia sent silks and peltry; France, woollens, bonnets, gold-lace, sugar, coffee, and indigo; Holland, cloth and spiceries; and England, woollens, muslins, linens, metal, wrought and unwrought, watches, trinkets, jewellery, and colonial produce. (Beaujour, Let. xvii. xxiii.) Except Russia and England, all those states make a part of their returns in specie. The late long wars, however, must have made a considerable change in the distribution of this trade. The new establishments of Britain in Malta and the Ionian islands must have transferred to her a part of what was formerly in the hands of the French and Italians.

Cotton.

Cotton, according to Beaujour, ranks first among the staple exports of Greece, and four-fifths of the trade in this article is conducted at Salonica. On an average of the ten years ending 1797, the district of Seres in Macedonia, where the most extensive cotton plantations in Greece are, furnished 50,000 bales, or 5,000,000 okes for exportation, of which three-fifths went to Germany. The price varied from 80 to 160 aspres the oke, or averaged about a piastre. But in 1809 the export of cotton from Salonica amounted to 110,000 bales, or 11,000,000 okes, and the price having risen to 60, 85, and even 90 paras, must have averaged nearly at two piastres the oke. The export of the Morea, which, according to Pouqueville, consisted, about 1800, of two cargoes, probably 400,000 okes, must have increased from the same causes, and may be estimated at 600,000 okes. About 72,000 okes were shipped from Salona in 1805. Considerable quantities of cotton are raised in Albania, and more in Thessaly; and though a great proportion of these is consumed within the country, a part is exported by the ports of Volo, Arta, and probably also by Butrinto and Avlona. If we add for the exportation of these districts a quantity double of that of the Morea, or 1,200,000 okes, we may form a loose estimate of the whole export of cotton from Greece; which would thus amount, about 1809, to 12,872,000 okes, or 35,398,000 pounds,—a quantity nearly equal to what was exported by the United States in 1805. The value of this, estimated at $1\frac{3}{4}$ piastre the oke, would be 22,526,000 piastres, or about L.1,200,000 Sterling (taking the piastre at 1s. 1d. the value given by Dr Holland, from whom most of the statements are taken). The opening of the Continent, however, in 1813, for the admission of West Indian and American cottons, must have produced a great diminution in this branch of trade. *

Tobacco.

The trade in tobacco, of which Salonica is also the chief seat, seems to have latterly declined. Beaujour estimates the annual export of this article, between 1787 and 1797, at 60,000 bales, which went chiefly to Egypt, Barbary, Italy, and Germany; but Dr Holland, who travelled in 1812, estimates it only at 30,000 bales, or 3,000,000 of okes. The Morea, and the southern parts of Greece, generally raise little tobacco, but import a great part of what they use from Macedonia and Anatolia. Albania and Thessaly, however, yield a large produce, and export to some extent. We have no account of the precise quantity, but if we suppose it to be one-fifth of what is shipped at Salonica, the whole export of this article would amount to 3,600,000 okes, which, valued at 36 aspres the oke (about $1\frac{3}{4}$d. the pound), including custom-house duties, would amount to 1,080,000 piastres, or L.67,500. †

Corn.

The exportation of corn to foreign countries is prohibited in Turkey, but is carried on to a great extent clandestinely, by the beys and pachas themselves, or by merchants to whom they sell, for a large sum, the privilege of violating the law. During the unsettled state of the west of Europe, the trade of Greece in corn seems to have increased rapidly. According to Beaujour, the export from the fertile provinces of Thessaly and Macedonia, by the ports of Salonica, Orphano, and Volo, consisted annually of 80 cargoes to other parts of Turkey, and 40 to France and Italy, making in all 1,200,000 kilos. In 1809 Dr Holland estimates the export from Salonica alone at 1,000,000 kilos of wheat, 500,000 barley, and 100,000 maize, altogether equal to about 200,000 quarters. About 50 cargoes of wheat and maize are sent from Arta to Sicily, Malta, and the Ionian isles; 100,000 kilos from Salona, and 250,000 from Livadia. The Morea, according to Pouqueville, sends out eight cargoes, or, according to Scrofani, about 240,000 kilos. If we put these quantities together, taking the cargo, according to Beaujour's valuation, at 10,000 kilos, and allow for the exports of Thessaly by the Gulf of Volo (which is not included in Dr Holland's statement), and of North Albania by Avlona, Durazzo, and other ports, a quantity equal to what is shipped at Arta, we shall have, for the whole export of continental Greece, in corn, 3,190,000 kilos, or 400,000 quarters. The greater part of this consists of wheat, the price of which was latterly from $5\frac{1}{2}$ to $6\frac{1}{2}$ piastres the kilo. Beaujour states the value of bread corn in his time at $2\frac{1}{2}$ piastres; and Scrofani reckons the grain of all kinds exported from the Gulf of Arta worth 3 piastres the kilo. If we assume the average in 1809 to be $4\frac{1}{2}$ piastres, the value of the whole exportation would be about 14,950,000 piastres, or L.809,700 Sterling. ‡ This may be considered as the true value of the grain, only a

* Beaujour, Let. ii.; Holland, p. 84, 389; Pouqueville, p. 206.

† Beaujour, Let. iii.; Holland, 84, 151, 349; Pouqueville, 411.

‡ Beaujour, Let. iv. and xxiii.; Holland, p. 84, 389, 395, 517; Pouqueville, 206; Walpole, p. 226.

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small share of which, however, goes into the pocket of the grower, imposts and exactions by the public officers absorbing the greater part. Considered in reference to the extent and circumstances of the country, the exportation now stated is very large. Estimating the whole population at 2,500,000, and allowing a septier of corn (about 4½ bushels) to each, according to Beaujour's calculation,* the whole consumption of the country will only amount to 1,400,000 quarters; and the corn exported will form nearly one-fourth of the entire produce.

Wool.

It has been stated that only a small proportion of the wool of Greece is wrought up in the country; but the amount of the export does not seem to warrant this assertion. From Salonica, according to Beaujour, the quantity exported is about 500,000 okes annually; from Salona, in 1805, it was 140,000 okes; from the Morea, according to Pouqueville, two cargoes, or, according to Scrofani, 340,000 okes. As sheep-farming is a leading occupation in Thessaly, and still more in Albania, the quantity exported from these countries (independently of what is carried inland to Salonica), and from Ætolia and Attica, cannot be less than from Macedonia and the Morea together; and on these data the whole export of wool may be loosely estimated at 1,800,000 okes (4,950,000 pounds), which, at the average price of 20 paras the oke, is worth about L.56,000 Sterling. Considering the reputed number of flocks in Greece, and the small proportion of the wool said to be used in domestic manufactures, this estimate is probably below the truth. The Jews of Salonica, who were refugees from Spain two centuries ago, obtained from the Ottoman government the privilege of buying up one-fifth of the wools grown in Macedonia, at 4 paras the pound; and this oppressive privilege they are still permitted to retain and abuse. †

Oil.

The exports of Attica in olive oil, according to Beaujour, are 150,000 measures (of 12 pounds each), or about 14,000 barrels, at 48 okes to the barrel. Those of the Morea, according to Scrofani, are 21,000 barrels; Salona, in 1815, shipped 5000 barrels; and large quantities are sent out from the Gulfs of Valo and Arta, from Avlona, and probably from Salonica and Orphano. Considering the extent to which this tree is cultivated over all Greece, the annual produce for exportation would certainly be moderately estimated at twice the amount of the quantities above enumerated, or 80,000 barrels. The value of this, at 20 piastres the barrel, is L.100,000 Sterling. ‡

Currants.

The commerce in currants centers chiefly in Patrass, from which, according to Beaujour, 8,000,000 pounds are annually exported, the total value of which, at 80 piastres the thousand pounds, is L. 40,000 Sterling. Dr Holland states the export from Patrass at 5,000,000 pounds; Scrofani at 6,000,000. (Beaujour, Let. viii.; Holland, 433.)

Miscellaneous Articles.

The only exportable commodity, worth naming, possessed by Attica, besides oil, is its honey, which is famed over all Turkey. Of this article and wax it exports to the value of 100,000 piastres. Twenty or thirty cargoes of timber are sent from the Gulf of Arta, besides large quantities from Macedonia and Thessaly; and from one or other of these districts are also exported silk, wine, hare-skins, honey, opium, drugs, bees-wax, carpets, and some capots, and other coarse woollen cloths. Vermillion and madder are exported from Livadia. Of the nature and extent of this trade, we can only form a judgment, by referring to that of the Morea. Besides the produce of corn, oil, currants, cotton, and wool, formerly mentioned, the Morea exports, on an average, according to Scrofani, silk, to the value of 407,000 piastres; cheese, 459,000 piastres; cattle, 240,000; fruits, 139,000; dye-stuffs, 202,000; wax and honey, 140,000. These, with smaller articles, to the value of 238,000 piastres, make a total of 1,725,000 piastres. From this must be deducted the value of goods sent to other parts of Greece, supposing it to equal the imports of the same description, viz. 316,000 piastres, which leaves 1,409,000 piastres. If we suppose the trade of the north of Greece, in these miscellaneous articles, to be three times as great as that of the Morea (the ratio of the population is about 5 to 1), or 4,227,000 piastres, we have a sum of 5,950,000 piastres, or L. 377,000, to add to the value of the exports of Greece, in the great articles formerly enumerated, § and the whole will stand thus :—

Cotton, raw and spun - -	L. 1,200,000
Tobacco - - - -	56,000
Corn - - - - - -	809,700
Wool - - - - - -	67,000
Olive Oil - - - - -	100,000
Currants - - - - -	40,000
Miscellaneous articles - - -	377,000
Total exports of Continental Greece,	L. 2,649,700

We are sensible that so many uncertain elements enter into this table as to detract greatly from its authority; but the reader is aware of the data from which it is compiled, and can judge for himself. The multitude of particular facts, given by different travellers, seem to be of little value, except as materials for some such general estimate, and the writer of an article of this kind is evidently in a better situation to form such an estimate than an ordinary reader.

* The consumption of each individual in England is computed to be about 1 or 1¼ quarter of grain; and though the inhabitants of Greece live much on gourds, melons, chestnuts, and other substances of that kind, the estimate of Beaujour is certainly rather low.

† Beaujour, Let. v.; Holland, 389, 84, 517, 499; Pouqueville, 206.

‡ Beaujour, Let. vi; Holland, p. 84, 349, 389, 517; Pouqueville, 411.

§ Beaujour, Let. vi. ix.–xi.; Holland, 84, 389; Clarke, vii. 465–8; Mentelle and Malte Brun, *Geog.* X. 215; Pouqueville, 411.

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With regard to this amount, it is proper to observe, that it refers to the period of 1809, when the commerce of Greece was forced up to an unnatural magnitude by the singular state of western Europe. The peace of 1814 must have reduced both the quantity and value of the cotton and grain exported, probably to the extent of a third or more. We may remark farther, that the sum expresses the value of the articles to the foreign purchaser at the place of export, which includes duties and charges, amounting, in some cases, to one-third of the value; and, with regard to the article of corn, a considerable part is carried away without payment, as the produce of a tax; another part is forced from the grower, at a fifth or sixth part of its value, for the supply of the capital, while the sale of the remainder is either monopolized by the beys, or subjected to an arbitrary impost, paid as a bribe for permitting the exportation, in violation of the law. (Beaujour, Vol. I. p. 119.) So great a proportion of the value is diverted into the pockets of the various classes of public functionaries, that the effect of the exportation, in stimulating domestic industry and production, is infinitely less than the aggregate amount would lead us to suppose. But when the extent and population of country is considered, and the multiplied discouragements to industry, arising out of the government and state of society, the trade is surprisingly great, and shows what a high rank Greece would attain, as a commercial state, were her industry unfettered.

Beaujour has given a general estimate of the commerce of Greece, computed on an average of the years from 1787 to 1797; but as this estimate refers only to certain districts of the country, and with regard to these districts, includes only the trade with foreign nations, and not that with the other parts of Turkey and Barbary; and besides, as subsequent events have made a great change both in the distribution and amount of this trade, we have not considered his table as the most eligible basis for an estimate of the total amount of Greek commerce, at a recent period.

In the trade with the northern and western parts of Europe, according to Beaujour, the goods imported by Greece formed only about five-ninths of the exports, the balance being remitted in specie. Scrofani also makes the balance of trade between the Morea and all other countries in favour of that district, though only to a small extent. But it is well known that there is often much fallacy in such calculations.

ipping d Seamen.

Though still proceeding on conjectural grounds, we may venture a step farther, in order to get at some idea of the naval resources of the Greeks. If we take the imports of the Morea (given by Scrofani) as a basis for the whole country, we should conclude that the trade of Greece, with other parts of Turkey and Barbary, is to her trade with foreign nations nearly as 5 to 4. And, in a period of war (1809), when the Greeks appeared in the character of neutrals, it is probable that the whole of the former trade, and two-thirds of the latter, would be carried on in Grecian bottoms. In this and other particulars, the commerce of Greece bore a general analogy to that of America, both countries exporting raw produce of the same kind, and importing manufactures, and both acting in the character of neutrals. On the ground of this resemblance, we will suppose the coasting trade of Greece and its islands to employ about half the tonnage of its other trade. In 1810 we find the whole tonnage of the United States (foreign and coasting) was, to its exports, in the proportion nearly of 1 ton to 48 dollars; but allowing for the inferior efficiency of Greek shipping, and the difference in the value of money, although their voyages are shorter, we may assign 1 ton to 36 dollars, as the proportion in the latter. This gives about 340,000 tons of shipping, of all sizes; and since the danger from pirates, as well as their own want of nautical skill, oblige the Greeks to employ an extra number of hands in their vessels, we may allow one man to 10 or 12 tons, which will give 30,000 seamen. If we add half as many more for the Greek mariners employed at Constantinople, Smyrna, and other ports beyond the limits of Greece, the whole number of mariners of this nation, in 1809, may be estimated at 45,000, which does not fall greatly short of the number mentioned by Mr Hobhouse. Should Greece ever seriously attempt to recover her independence, such a naval force will be of essential service to her in the struggle.

Wages of Labour.

The proportion between the rate of wages and the price of commodities in Greece affords an illustration of the dependence of the former on the habits of the population. The numerous fasts of the Greek church keep the peasant idle a great part of the year; and the consequence is, that, as he must have the means of subsistence, his wages, during the time he labours, are so much higher. Thus, Beaujour tells us, that, in his time (from 1787 to 1797), the wages of a peasant were from 20 to 25 paras a-day—of an artizan, 30 to 40 paras; and, at the same period, beef was sold at 6, mutton at 12, and bread at 4 paras the oke ($2\frac{3}{4}$ pounds); and corn was $2\frac{1}{2}$ piastres the kilo or bushel. Supposing a full aged labourer to consume six or seven kilos of corn in the year, he observes, that such a person could earn bread for himself, for a whole year, in 36 or 40 days, and food of all kinds in 80; that he could provide subsistence for himself and his wife in 160 days; and for a child, besides, in 40 days more. The vast number of fasts, as he remarks, are the chief cause of these high wages, which do not enable the labourer to live well, but to live idle, and indulge his superstitious feelings. (Beaujour, ii. 168.)

Provincial Governments.

The provincial governments of Greece bear the different denominations of pachalik, mousselimlik, agalik, vaivodalik, according as they are administered by Pachas, Mousselims, Agas, or Vaivodes. The pachas are the first of these functionaries in rank, and govern the largest districts; the others follow in the order in which they are named. The agas often take the title of Bey, though that belongs properly to military commanders, one degree higher. The most essential distinction between them regards the extent of the districts they govern; for they are all independent of one another, and accountable separately to the general govern-

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ment. Each, as vicegerent of the Sultan, exercises the full powers of sovereignty within his own district. This seems to be the theory of the government; but as theory and practice seldom coincide in Turkey, we find that in the Morea, and perhaps in other parts, the beys or agas are, to a certain extent, dependent on the pachas. The limits and the numbers of these provincial governments are often in a state of fluctuation, in consequence of the hostilities which the beys and pachas carry on against one another. The enterprising ambition of Ali, the Pacha of Albania, has nearly obliterated all the ancient political divisions of Northern Greece. In 1812, the provincial governments consisted of five pachaliks, two vaivodaliks, and a number of smaller districts, governed by beys, or officers of inferior rank. These were, 1. The pachalik of Albania, now comprehending the territories which formerly constituted the pachaliks of Lepanto, Arta, Janina, Delvino, Ocrida, Avlona, with the mousselimlik of Larissa, and several towns and small districts governed by beys, agas, or vaivodes; the whole comprising the ancient Epirus, Acarnania, Ætolia, Phocis, the greater part of Thessaly, the southern division of Illyricum, and the western divisions of Macedonia and Bœotia. 2. The pachalik of Scutari, consisting of the country watered by the Drino, a part of the ancient Illyricum. 3. The pachalik of Salonica, including all the lower part of Macedonia, except the districts belonging to the Pacha of Albania. 4. The pachalik of Negroponte, consisting of the eastern part of Bœotia, and the island of Eubœa or Negroponte. 5. The pachalik of Tripolitza, comprehending all the Morea, except some maritime towns and districts. The pacha has under him twenty-four officers, governing the different cantons, some named Beys, and others Codja-bashees or elders. 6. Attica and Livadia are each governed by a vaivode. 7. The high country of Macedonia is divided among a number of beys or agas. 8. The small territory of Zagora, the ancient Magnesia, is under the government of the Greek primate of the country. 9. The district of Maina, in the Morea, is disjoined from the pachalik of Tripolitza, and though nominally subject to the Capudan pacha, actually enjoys a great degree of independence, under the sway of its own beys, who are twelve in number, and live much in the condition of feudal barons. 10. All the Greek islands, with some maritime districts on the mainland, are under the authority of the Capudan pacha. This enumeration of the provincial governments is not so perfect and detailed as could be desired, but it comprises the best information we have been able to collect from a considerable variety of sources.*

Civil Polity.

The civil polity of the Turks is in substance the discipline and arrangements of a Tartar camp applied to the government of a nation. The pasha, like the commander-in-chief, determines every matter civil, military, and judicial, with summary dispatch, and without reference to any other rule than his own untutored conceptions of right and wrong. Those public boards and organized bodies, by which the civil concerns of other nations are administered, are scarcely known, and the system of government of course takes its complexion entirely from the personal character of the chief. Questions not of a criminal nature, however, between subject and subject, are decided by the mollah or judge, whose jurisdiction extends over both Turks and Christians. In the tribunals of these functionaries, bribery is almost open and avowed; and false witnesses form something like a regular profession. The gainer of a suit pays the whole expences. The Turks themselves, aware of the notorious corruption of the courts, rather submit to injustice than seek legal redress. The Greeks and Jews generally submit all differences amongst themselves to their patriarchs and rabbins, in the way of arbitration; and the decisions of these persons, though not in right, are, in fact, without appeal; because they are enforced by anathemas which inspire such terror that they have sometimes caused husbands to be deserted by their wives, and fathers by their daughters. Avanies, or vexatious prosecutions instituted against Christians, for the purpose of compelling them to pay a sum of money as the price of abandoning the suit, are a regular source of revenue to the Turkish inhabitants of towns. The police of the Turks is as rude as their judicial system. An officer accompanied by soldiers traverses the markets in the great towns, and if he detects any person selling with false weights, the defaulter receives the bastinado for the first offence, is nailed by the ear to the door of his own shop for the second, and hanged for the third. Their attempts to correct evils often produce others of much worse description. If a complaint is made by some person of consequence, of a robbery committed, an enormous fine is levied on the district where it happened; or, what is still worse, a party of soldiers is sent out, who, under the pretext of searching for the robbers, oppress and plunder the peasants without mercy. An officer named *Dervendgi-pacha*, charged with the inspection of the roads and bridges, makes an annual tour through the country, accompanied by a party of soldiers; but his inspection serves no other purpose than to extract money, under the name of fines, from the people, to fill his own pockets, while the roads and bridges are utterly neglected. Indeed, all classes of public officers practise extortion, and Turks, Greeks, and Jews, are almost equally sufferers. Public offices are regularly sold to the highest bidder, and those who buy them of course reimburse themselves by one means or another. As the appointments are annual, the price is paid over again every year; and the only method of redress which is open to a city or district that is oppressed, is to offer a greater sum for the removal of its governor than he gives to obtain the renewal of his office. Very often, after an aga has amassed great riches, the porte allures him into some large town, by the bait of a splendid employment, and there

* Beaujour, Let. i.; Pouqueville, Chap. x; Thornton, p. 122; Hobhouse, Let. xiv. xvii.

strips him of his wealth, and perhaps awards him the bowstring. The pachas live surrounded with a degree of pomp and splendour, which contrasts strangely with the squalid wretchedness of the people they govern. They are approached with prostrations, like eastern monarchs. Their places of residence are vast buildings—forts without, and palaces within, capable of containing a thousand or twelve hundred men. Besides a strong body of soldiers, they are filled with an immense retinue of servants, including menials, tradesmen, and artists; such as coffeemakers, sherbetmakers, confectioners, bathers, tailors, barbers, dwarf pages, black slaves, buffoons, musicians, puppet-show-men, wrestlers, conjurors, dancers, an imam (or priest), and, lastly, the executioner, the pacha's confidential servant, without whom he never stirs abroad, and who is the only person privileged to sit in his presence. In addition to all this, the harem, or women's apartments, forms a separate establishment, with its own train of servants. A pacha of Salonica, not peculiarly profuse in his habits, has been known to expend L. 24,000 *per annum* on his domestic establishment. The mousselims, agas, and beys, support the same state in proportion to their circumstances. Wars are as common among these petty rulers as among the old feudal barons, and as destructive in their effects. The porte, by a miserable policy, foments their quarrels, to weaken them individually, and increase their dependance on itself. The people, ruined by exactions, or the ravages of the military, abandon their homes, and fly to the mountains and forests, where they commence robbers. In some places the rural inhabitants live in houses which are built like small forts with draw bridges and battlements. In addition to all the evils common to them with the Turks, the Greeks have many peculiar to themselves. They are made to feel their degradation by the most opprobrious distinctions. They are marked out by a peculiar costume; and are not allowed to wear certain articles of dress,—or clothes or slippers of a light colour; or to paint their houses of those colours which the Turks use. It is death for a Greek to marry a Turkish woman, or to strike a Mahometan even in self-defence. One of the lowest Turks will dismount from his horse, force a Greek from his shop, load him with his baggage, and compel him to follow him, without the poor Greek daring to utter a complaint. The wealthiest individuals of this nation are exposed to the most galling insults in their own houses. Dr Holland mentions, that while he was sitting with the Archbishop of Larissa, the most considerable Greek in Thessaly, a Turk of a surly and forbidding aspect, and evidently of the lowest class, entered the room, seated himself unceremoniously on the sofa, filled his pipe, and took coffee from the attendants. The Archbishop was evidently embarrassed, but made no comment. After a short interval, he took a coin from his purse, and put it silently into the hand of the Turk, who immediately disappeared. In general, the inhabitants of the districts which are appanages of the great officers of state,—of the *timars* or fiefs held under the sultan,—and of the lands belonging to the church, are less oppressed than the others. The islands of the Archipelago, where Turkish governors do not reside, are also less disturbed; and mountainous districts, such as Maina, which are capable of being defended, are sometimes nearly in a state of independence. Local differences, indeed, in the political condition of the people, are numerous in Greece. Where the Christian inhabitants have wrested certain privileges from the Turks, they generally enjoy them undisturbed, from the mechanical adherence of the latter to habits once formed. Very often the degree of freedom and security which the Greeks enjoy depends on their numbers. In towns where they form a large part of the population, as in Athens, their numbers and union give them consequence, and their superior knowledge and address enables them successfully to elude or oppose the sluggish tyranny of the Turks. In Albania, the severe government of Ali has repressed the insolence of the Turks, but without raising the condition of the Greeks. He has, however, reduced the numerous bands of robbers who infested, or rather occupied the country; he has built bridges, made roads, given security to merchants, and, upon the whole, greatly improved the condition of the people. *

Military Force.

The Turkish government being purely military, the privilege of carrying arms is considered a mark of distinction, and is reserved entirely to the Turks. Nearly the whole of this part of the population belongs either to the *Toprakli* (feudal militia) or to the corps of janizaries. A Mahometan, unconnected with any military corps, is equally with Christians liable to capitation-tax and other imposts; and this law, though not rigorously enforced, induces most of the Turks to enrol their children in their infancy. Hence in the cities every Turk is a janizary. But only a very small number of these are embodied; the whole corps of janizaries in actual pay in the empire being only about forty thousand, according to Mr Thornton. They serve in garrisons, and generally follow some trade. Their pay was originally about one shilling a-day, and though still nominally the same, is now, from the depreciation of the coin, reduced to a fourth part of this sum. Small companies of *topgis*, or artillerymen, are also placed in the garrisons, but they are totally ignorant of gunnery; and very often the guns are without carriages. The *yamacks* or unembodied janizaries, and spahis, serve merely to fill vacancies in the standing corps, and furnish extraordinary levies in time of war. These levies are made at the rate of one man out of ten persons of the families attached to the military bodies. When called upon for active service, they march without uniforms, armed with fowling-pieces, pistols, lances, or such weapons as

* Pouqueville, p. 26, 122; Beaujour, Let. i.; Thornton, Chap. iii., iv.; Holland, 110, 120, 289, 343; Eton, 104, 358; Hobhouse, 118, 289; Walpole, p. 20.

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they can find. The Albanians, from greater practice in war, are better organized, though destitute of what would be considered discipline in regular armies. Many of the pachas, indeed, now keep in their service a corps of Albanians, who have become the principal, and far the most efficient part of the Turkish military in Greece. We do not find any accurate account of the amount of the military force actually kept on foot in Greece, or of the contingent furnished by it for the general service of the empire. But the pachaliks of Salonica, with the mousselimlik of Larissa, which have a population of 500,000 souls, Greeks, Jews, and Turks, supply, in time of foreign war, 15,000 men; and as the proportion of Mahometans is much greater in these districts than anywhere else, perhaps the contingent for the whole country, including Albania, will not exceed three times this number. But so inefficient is the military administration, that generally not more than one half of the individuals called upon actually join the army. The Pacha of Tripolitza has in his service a body of five or six thousand Albanians, which may be considered as the standing military force of the Morea. The Pacha of Albania, the most formidable military power in Greece, has seldom more than 8000 men in pay, according to Mr Hobhouse. But Dr Holland, who wrote at a later period, when Ali's dominions were much more extended, estimates his standing army at 15,000; and thinks he could, for a short time, maintain 30,000 men in arms. As nearly one half of the Peninsula of Greece was, at the latter period, subject to Ali, containing a population of 1,200,000, or 1,300,000 souls, the estimate seems exceedingly moderate; and the whole military force of the country applicable to any emergency, calculated on the same scale, would be 60,000 men, or one-tenth of the males able to bear arms. The pay of Ali's troops is said to be twelve piastres, or fifteen shillings a-month, besides provisions, which are furnished to them by the villages where they are quartered. The Albanians of all classes possess arms. Those in active service use a sabre in addition to the gun, pistols, and poinard which the peasantry carry. Pouqueville speaks of them as being formed into chiliads or bodies of a thousand men each, which are subdivided into companies; but these companies do not consist of a fixed number. They have few cavalry; and their infantry is without tactics, discipline, or regular order. Ali has made some attempts to introduce the European discipline, but found the habits of his subjects totally averse to it. The men, however, have the military virtues in a degree not surpassed by any nation in Europe; and their impetuous courage has often snatched victory from an enemy superior in numbers and technical skill. They are strong, hardy, active, and enterprising; they delight in combats,—are daring in action, even to rashness, and firm in the midst of dangers.*

Greece. Revenue.

The public revenues of Greece, like those of other rude countries, consist of a number of imposts, raised on a very simple plan, and often so much the more oppressive for this simplicity. The expedients adopted in other states to lighten and equalize the pressure of taxes, and to mitigate their injurious efforts on industry, are totally unknown in Turkey. Most of the taxes were imposed in rude times by men skilled in nothing but the use of the sword; and the paramount authority of custom, which in Turkey controls equally subject and sovereign, will not allow of any material alteration. There are, however, local variations, both in the amount of the taxes, and in the mode of their imposition. 1. The first of the Turkish taxes is the *miri* or land-tax, which affects equally Turks and Greeks, and consists of one-tenth of the gross produce of the soil. Beaujour estimates its actual amount at one-twelfth. Vineyards and gardens, with ground under cotton, madder, and mulberries, generally pay a composition. 2. A tax on moveables, that is, shops, houses, furniture, &c. affecting all other classes but Turks: it is assessed in a very arbitrary manner; varying much in different towns; and is estimated by the Greeks to absorb a fourth part of their gains. 3. A tax on consumable commodities, cattle, provisions, firewood, liquors, &c. levied at the gates of towns, at rates probably not uniform. Sheep and goats pay one para, an ox one piastre, wine two, and brandy four paras the oke; compositions are accepted for other articles. 4. The karatch, or capitation-tax, imposed on all males, not Mahometans, who are above twelve years of age, according to some, above five, or eight, according to others. The rate varies from two to ten piastres, according to the supposed wealth of the person, and may vary to a still greater extent, as it is levied on the basis of an ancient roll or census, and, when the population of a district diminishes, the rate is raised in order to afford the same annual amount. The officers judge of a child's age by putting a cord round its head. The person paying receives a ticket, which he is obliged to produce at the gates of towns, and if he fails, he is compelled to pay anew, perhaps with the addition of the bastinado. 5. A duty on exports and imports, amounting, generally, to 3 *per cent.* when the merchant is a foreigner, and 5 or 6 *per cent.* when he is a native subject. 6. The property of all public officers at their death, and of all persons who die without heirs, devolves to the pacha, on behalf of the Grand Seignior. By a composition, however, the heirs of a public officer are sometimes allowed to retain his property. 7. Each pacha has generally a number of farms and villages attached to his place, of which he draws the rents. Ali is reported to be the proprietor of 400 villages, which yield him L. 200,000 *per annum*. Mr Hughes thinks that one-third of the whole cultivated territory belongs to him. 8. The arbitrary requisitions made of horses,

* Thornton, Chap. v.; Beaujour, Let. iv.; Hobhouse, Let. xii. xiii.; Pouqueville, Chap. x. xxxiii.; Holland, p. 111.

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forage, and provisions, for the public service, are a productive source of revenue. 9. Large sums are drawn from the sale of public offices, including those of the dignitaries of the Greek church. The inferior clergy are also compelled to pay a sum at their installation. 10. In some provinces, perhaps in all, there is a duty on legal proceedings, amounting to one-tenth of the value of the disputed property. 11. *Avanies*, or vexatious prosecutions; and fines levied on districts for crimes committed within their bounds, on the ground that they might have prevented them. This last practice is made a pretext for many grievous acts of extortion and cruelty, the inhabitants being subjected to military execution when they are unable to pay. 12. Sums are wrung from the tributary classes, as a composition for working at the highways and fortifications; but the money passes wholly into the pockets of the public officers. 13. A considerable revenue is derived from escheats, forfeitures, and confiscations; and a trifling amount from the produce of the mines, all mines being regarded as the Grand Seignior's property. Lastly, the *Istira*, or regulation by which the cultivators are compelled to furnish corn for the supply of the capital, at one-fourth or one-fifth of its market value, operates as a tax on the husbandman, though it bring little into the treasury of the prince. Many of these taxes are farmed; but certain districts, as Maina, and certain bodies of men, as the Jews of Salonica, are allowed to make a composition with the government, under which they assess and collect their taxes (wholly or in part) themselves. Were we to judge of these taxes by the amount paid in to the government, we should pronounce them extremely light. But the unequal and often arbitrary mode of apportioning and collecting them, are sufficient to render the lightest impost oppressive, and the numberless fraudulent demands for which they afford a cover on the part of the revenue officers greatly aggravate their pressure. From isolated facts stated by various writers, we are warranted to believe, that the gross revenue, or the money drawn from the people, is generally double, sometimes triple, of what is paid even to the provincial governments.*

We have no account, on which the smallest reliance can be placed, of the whole produce of the taxes of Greece; and the statements with regard to those of particular districts are too contradictory to be received without suspicion. Mr Hobhouse heard the revenues of Ali estimated at six millions of piastres, exclusive of casual levies (a very comprehensive head). Attica has been said to remit annually to Constantinople 700 or 750 purses (of 500 piastres each). According to Pouqueville, two millions of piastres are raised in the Morea, of which only one-half is paid in to the pacha. There is very little consistency in these statements. If we take the first as a basis, and assume that Ali's territories comprehended one-third of Greece at the period alluded to, the revenue of the whole peninsula might be estimated at eighteen millions of piastres, or L. 1,100,000 Sterling, exclusive of what are called casual levies. But, from the vigour of Ali's government, his revenue is probably greater in proportional amount, and collected at a less expence, than that of any other provincial ruler. A different mode of calculation would conduct us to a similar result. In the least advanced countries of Europe, such as Spain, Portugal, Austria, Russia Sweden (see article EUROPE, *Supplement*), the public revenue, compared with the population, is generally at a rate varying from 8s. to 15s. Sterling *per annum* for each inhabitant; and as Greece is certainly near the bottom of the scale in point of productive industry, her revenue can scarcely exceed the lowest of these rates. Calculating on this principle, and supposing the population to be two millions and a half, the net revenue would be L. 1,000,000 Sterling, and this sum doubled may represent the gross amount extracted from the pockets of the people. †

It is not true, as has sometimes been stated, that the taxes in Turkey have been immemorially the same. The tax on consumable commodities was first imposed during the reign of Abdul Achmet, late in the last century, and probably several others of those enumerated are of modern date. But the government certainly has not the same ready access to the pockets of its subjects as those governments which are supported by Parliaments or States General. The Turks, who are the slaves of custom, would think themselves degraded if they submitted to exactions unknown to their ancestors, and the Grand Signior must respect their prejudices. But no such motives operate to protect the *raias*, or tributary classes, from new impositions; and indirect schemes of taxation may reach the Turks also.

Municipal, and other local charges, are defrayed by the three classes of Turks, Greeks, and Jews, who are organized for this purpose into a sort of corporate bodies. In Salonica, the Turks are governed by a council of six Ayans, who are generally powerful Beys; the Greeks by their Proesti, or Primates, as every where else; and the Jews by a council of Rabbins, whose head, called Kakam, usually places himself under the protection of some Christian power. These persons ought to be a check on the public officers, and they are sometimes the channel through which remonstrances are made, and justice obtained; but more generally they are accomplices in the extortion and oppression practised on their respective communities. (Beaujour, Let. i.)

Population.

Of the various estimates given of the population

* Thornton, Chap. vi.; Beaujour, Let. i.; Pouqueville, Chap. x.; Holland, p. 115; Hobhouse, p. 296; Hughes's *Travels*, Vol. II. p. 82.

† The ancient Athenian revenues consisted of, 1. Contributions from the allies, which amounted to 600 talents in the time of Alcibiades. 2. Customs at the rate of 2 *per cent.* on imports and exports, which yielded about 36 talents. 3. Confiscations of the property of individuals. 4. Rents and produce of mines and marble quarries. 5. Capitation-tax on Μετοικοι, or strangers permanently resident in the city. Xenophon estimates the whole at 1000 talents, or L. 250,000. (Walpole's *Memoirs relating to Turkey*, p. 435.)

of Greece, that of Beaujour has been most generally followed. This writer assigns a population of 700,000 souls to Macedonia, 300,000 to Thessaly, 400,000 to Epirus, 200,000 to Etolia, Phocis, and Bœotia, 300,000 to the Morea, and 20,000 to Attica, making a total of 1,920,000. In two particulars, this statement seems to require correction. The population of the Morea, since the desultory war of 1770, appears to have been gradually increasing. Scrofani, on whose statement Beaujour probably grounds his own, estimates the number of inhabitants in that district at 250,000; but Pouqueville, who wrote at a later period, and had good means of information, estimates them at 400,000 Greeks, 15,000 Turks, and 4000 Jews. Again, Beaujour appears not to have included under the name of Epirus the district watered by the Drino, or even northern Albania; and the researches of Mr Hobhouse and Dr Holland have shown, that the parts of this country he did include are more populous than he imagined. An addition ought therefore to be made to Beaujour's enumeration on these grounds. Dr Holland, on the other hand, appears to have greatly overrated the population of part of the country. Ali's territories, circumscribed by the boundaries which the Doctor has traced, embrace an area of about 26,000 square English miles. Pouqueville estimated the population at a million and a half; and Dr Holland thinks it must be nearly two millions, which is equal to seventy-seven persons to each square mile. But Spain, a country resembling Albania in its physical features, with a larger proportion of arable soil, and a greater internal tranquillity, has, on an average, only fifty-five or sixty inhabitants to a square mile; and it is certainly extremely improbable that Albania should have more, or even so many. Considering the circumstances of the country, fifty persons to a square mile may be thought a high estimate. This would give 1,300,000 inhabitants for the whole of Ali's dominions. If we add to this, 420,000 for the Morea, 100,000 for Attica, Eubœa, and the eastern part of Bœotia, 600,000 for Macedonia (exclusive of the part in Ali's possession), 200,000 for the pachalic of Scutari, and 80,000 for the Cyclades, we shall have 2,700,000 for the entire population of Greece. Perhaps the number of inhabitants was not greater in Strabo's time, if we may judge from the account he gives of the deserted state of the country (Lib. vii. p. 322); and the government of the Turks, with all its train of abuses, is probably not more destructive to Greece than that of the Romans was. This population is very unequally distributed. It is densest in the southern parts of Macedonia, in the eastern parts of Thessaly, and in the central and northern districts of Albania. Acarnania is almost a desert; Ætolia is thinly peopled; Attica, including the city, has not more than twenty-five or thirty inhabitants to the square mile. The plains of Argos, and the hilly region of Maina, are the most populous parts of the Morea. As might be expected from the insecure state of the country, single cottages or scattered hamlets are scarcely anywhere to be seen. The inhabitants are always collected into villages or cities; and those who are engaged in husbandry waste a great part of their time and labour in travelling to and from their lands. Hence in the agricultural districts, the proportion of the inhabitants who live in towns seems unusually large, considering the small resources that trade and manufactures afford. Of 500,000 persons inhabiting the pachalic of Salonica, and the Mousselimlik of Larissa, one-third, according to Beaujour, live in the large towns. The most fertile districts are not uniformly the most populous. A barren soil in mountainous parts, which afford the means of defence, is often laboriously cultivated, while the rich plains below are neglected. *

It would be interesting to compare the modern with the ancient population of Greece in point of numbers. But inquiries with regard to the latter seem to lead into a labyrinth of difficulties, partly from the want of sufficient data, partly from the multitude of errors that have crept into the numerical expressions in the text of ancient authors, and partly from the civil distinctions of citizens, slaves, and strangers, which render the application of particular statements uncertain. It would baffle human sagacity to build any satisfactory conclusion on the mass of discordant details collected by Hume. We shall proceed more securely if we ground our reasonings on some single statement that is pretty well established. From a variety of circumstances which elucidate and fortify each other, Hume deduces that Athens contained at one period 284,000 inhabitants.† Let us suppose this to include, also, the rural population. Attica was com-

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* Beaujour, Let. i.; Holland, p. 113, 251, 280; Hobhouse, p. 176, 201, 487; Pouqueville, Chap. x.

† This conclusion is not without its difficulties. But if it involves any errors, they are errors of defect and not of excess. For any different construction of the text of Athenæus would give a larger number. See Hume's *Essay on the Populousness of Ancient Nations*. We may adopt another mode of calculation. The Spartans were the only power who regularly employed their slaves (Helots) in their armies, and whose military force may therefore be taken as a criterion of their whole population. They sent, of Lacedemonians and Helots together, 50,000 to fight the Persians at Platæa. The men were collected and sent off within the space of a day or two, and as the Messenians were shortly after in a state of revolt, it may be presumed that none of that nation were in the army. (Herodotus, Lib. ix.) If we suppose that this army contained one half of the males of a military age (and probably no country ever sent a larger proportion beyond its own confines), the whole population of Laconia would be 400,000; and that of Peloponnesus, on the same ratio, would be 2,000,000. Supposing the parts beyond the isthmus to be peopled only to three-fifths of the density of Peloponnesus, the whole population of Greece would be 8,300,000, an amount not materially different from the other. After all, it must be confessed that so general a conclusion, built

Greece. paratively a barren district; and, exclusive of Eleusis, Megara, and Salamis, did not occupy more than one-sixtieth part of the countries to which our statements apply in this article. Its commerce and colonies, however, more than compensated for the inferiority of its soil. Now, if we suppose the other and more fertile, but less improved parts of Greece, to have been peopled only to one-fourth of the density of Attica, this would give a population of eight millions and a half for the whole country. Without relying much on this calculation, we may observe, that, if one amidst a multitude of small states had such a mass of population, her neighbours and rivals must have possessed something like a proportionate strength to preserve their independence. And, considering the strong feeling of emulation which pervaded these small republics, we may be certain that, before the arts of industry could be so far advanced in Attica as to enable such a mass of people to subsist on so small a surface, the neighbouring states must have been considerably improved.

Towns. We have stated that a small proportion of the inhabitants of Greece live scattered through the country. Were this circumstance not attended to, the number of large towns mentioned by travellers would lead us to conclude that the country is more populous than it really is. We subjoin the names of some of the most considerable towns, with the estimated population:

ALBANIA.		
Janina, - -	35,000	Hobhouse.
Argyro Castro, -	20,000	do.
Berat, - -	15,000	Holland.
Metzovo, - -	8,000	do.
Paramithia, -	9,000	do.
Avlona, * - -	5,000	do.
Arta, - -	5,500	Hobhouse.
Scutari, - -	12,000	do.
Dulcigno, - -	6,000	do.
MACEDONIA.		
Salonica, - -	70,000	Holland.
	60,000	Beaujour.
Seres, - -	30,000	do.
Jenidge, - -	6,000	do.
THESSALY.		
Larissa, - -	20,000	do.
Vodina, - -	12,000	do.
Kara Veria, - -	8,000	do.
Tournavos, - -	6,000	do.
Pharsalus, - -	5,000	do.
Zeitoun, - -	4,000	do.
Volo, - - -	3,000	do.
Trikala, - -	11,000	Holland.
Makrinetza, -	6,000	Holland.
Ampelachia, - -	4,000	do.
Elasson, - -	6,000	do.
ATTICA AND BŒOTIA.		
Athens, - -	15,000	Clarke.
	12,000	Hobhouse.
Negroponte, * -	4,000	do.
Livadia, * - -	10,000	Holland.
Megara, * - -	3,000	Hobhouse.
Thebes, * - -	2,500	do.
ÆTOLIA.		
Messalonge, - -	5,000	do.
Natolico, * - -	3,000	do.
MOREA.		
Corinth, * - -	2,500	Holland.
Patrass, - -	10,000	do.
Vostitza, - -	3,500	Hobhouse.
Argos, - -	8,000	Holland.
Tripolitza, - -	15,000	do.
Calamatte, - -	5,000	Pouqueville
Mistra, - -	16,000	do.
Hydra (Island), -	25,000	Holland.

The towns of Greece contrast strikingly with those of western Europe in their general appearance. Founded rather as places of security, than with a view to commercial advantage, their sites are generally elevated and picturesque. Instead of the long and uniform lines of buildings seen in our cities, the houses often stand detached, and appear irregularly scattered over the ground. The tall, airy minarets, also, which break the outline in an agreeable and fanciful manner, and the groups of cypresses surrounding the mosques, which are seen blended with the buildings, give them a character of repose and softness, combined with richness, and even magnificence, which has a fine effect in the landscape. On a near inspection, however, their beauty vanishes. The mean buildings, the streets narrow and dark, seldom paved, and covered with offal and filth of every kind, grievously offend both the senses of sight and smell. The houses of the poorer classes are miserable hovels, built of mud and straw; those of the peasants in the country are often formed, like the huts of savages, of wooden poles rudely put together in the shape of a tent, and covered with turf. The houses of the better classes in towns are of wood, sometimes with a foundation of stone. They are pretty generally of two stories; the upper story sometimes projecting beyond the lower, in the manner of the old wooden buildings in Edinburgh, and the roof again extending far beyond the face of the upper wall, apparently for the purpose of giving shade and shelter to the streets below. The style

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on so narrow a basis, is scarcely better than a confession of total ignorance. It may be observed, that the greatest army which England ever sent beyond her own frontier, previous to the present times, was that with which Edward II. invaded Scotland, which consisted of 100,000 men.

* The population of the towns marked thus is computed from the number of houses, reckoning five persons to a house.

Greece.

of building is extremely uniform. The larger houses are built round a square area; the under story, used as stables and warehouses, has seldom any windows on the side towards the street, or it is shut in on that side by a wall, so as to give the house the appearance of a jail. The upper story presents, in front, an open gallery, with small windows, latticed with cross bars of wood, and serves chiefly to communicate with the apartments behind. The furniture consists of a very few articles, of a rich, or rather gaudy description; a divan or raised seat, from 10 to 15 inches high, stuffed and covered with silk, and cushioned behind for the back, extends round three sides of the room. A handsome carpet covers the rest of the floor. These, with a table of very plain construction, and two or three large mirrors in the corners, are generally all that a well-furnished Turkish room contains. The walls are sometimes wainscotted, and adorned with landscapes, or purely ornamental paintings. The roofs exhibit gilding and carved work. Many of the houses of the rich have gardens attached to them, inclosing fountains. The dwellings of the wealthy Greeks are in no respect different from those of the Turks. There is a total absence, in the Greek towns, of that noise, bustle, and activity which give such an animated character to our cities. There are no wheel-carriages of any kind seen, but loaded camels or horses are passing to and fro, through the dust or mud. Hawks and storks are flying about the trees, mosques, and houses; and great numbers of gaunt and half-wild dogs, which have no owners, are prowling about, picking up the offal thrown into the streets. One of the most interesting objects in a Greek town is always the Bazar or market. This consists of one, two, or more streets, filled entirely with shops or wooden booths. The dealers in the same class of articles are all ranged together. One street is occupied by those who deal in jewellery; another by those who deal in pelisses and shawls; a third by the retailers of common cotton goods; a fourth by the dealers in groceries, tobacco, &c.; a fifth by those who sell pipes, amber, mouth pieces, &c., and so on. These bazars are often shaded by wooden trelisses interlaced with vines, or by branches of trees laid across from the roofs of the opposite shops or booths.*

Different Races.

The population of Greece is composed chiefly of three different races, not more distinct in their origin than in their manners and character. These are the Turks, the Greeks, and the Albanians, with whom are intermixed a smaller number of Jews, Armenians, and Wallachians. It is extremely difficult to estimate, with any accuracy, in what proportions these different races are combined. The scanty information given by travellers on this subject is often rendered ambiguous by the indiscriminate application of the name of Greeks to persons attached to the Greek church, whether they are of that nation or Albanians. Except in some towns, and very limited districts, the Turks nowhere appear to constitute the majority of the population. They are most numerous in Thessaly, Macedonia, and Negroponte, are thinly diffused through the rest of Greece and Albania, and are scarcely seen at all in the islands. In the districts of Salonica and Larissa, where they most abound, they scarcely exceed, according to Beaujour, one-third of the inhabitants (180,000 out of 500,000); in Athens, according to Dr Holland, they amount to one-fifth; in the Morea, they form one-twenty-eighth part by Pouqueville's enumeration; in Livadia, there are few of them; in Acarnania and Ætolia, still fewer. In Janina, they are less numerous than the Greeks; and throughout Greece generally, except in Thessaly and Macedonia, there are very few Turks among the rural population. Without pretending to accuracy, on a point where accuracy is unattainable, we may, perhaps, estimate the Turks on these grounds at one-third of the inhabitants in Thessaly and Macedonia, and at one-tenth in the other parts of Greece and Albania on an average. The whole number of Turks computed on this principle would be 500,000, which is between one-fifth and one-sixth of the entire population.†

Turks.

Albanians and Greeks.

It is more difficult to form any satisfactory conclusions as to the respective numbers of the Greeks and Albanians. Colonies or parties of the latter people have, from time to time, settled in various districts of Greece. Nearly all of these belong to the Greek church. Some of them have preserved their native manners, dress, and language; others are gradually adopting the language of the Greeks; and as some of their settlements were formed more than four hundred years ago, and probably much earlier, it may be presumed, that numbers of the Albanian settlers have lost their distinctive character, and become blended with the mass of the Greek population. The whole of the peasantry in Attica, and the eastern part of Bœotia, and one-fifth of the inhabitants of Athens itself, are Albanians. They are found also preserving their peculiar character, and generally employed as shepherds, in some districts of Argolis, Elis, Arcadia, and Laconia. Dr Clarke met with them repeatedly among the rural population of Thessaly and Macedonia, to the extreme limits of the latter country, at Mount Pangæus. And if we might credit an extraordinary statement of his (Vol. VII. p. 119), we should conclude that the whole peasantry of Greece were Albanians. But this is irreconcilable with the accounts given by other travellers. Dr Holland, who was well apprized of the distinction between the Albanians and the Greeks, describes the peasantry of Thessaly as a very different race from the Albanians, and estimates the Greeks in this district at two-thirds of the population. In the countries south of Mount Œta, Doris, Phocis, and part of Bœotia, he thinks they are proportionably more numerous. In the Morea, Pouqueville met with Albanians frequently as shepherds; but the

* Holland's *Travels;* Hobhouse, Williams, *passim.*

† Beaujour, Let. i. iv.; Holland, p. 343, 395, 412; Pouqueville, p. 119; Hobhouse, p. 206; Leake's *Researches*, p. 375.

Greece.

Greeks there certainly outnumber the other classes in greater proportion than any where else, except in the islands. They are numerous in Ætolia, and form almost the entire population of Acarnania. In the capital of Albania they are the largest and most respectable class of inhabitants; and in the towns and villages of southern Albania generally they constitute the basis of the population. Every where the Greeks form a conspicuous part of the population of towns. In some of the large towns of Thessaly and Macedonia the Turks predominate in numbers; but in all the towns south of Mount Œta, with a very few exceptions, the Greeks form the great majority of the inhabitants. Except, therefore, in Attica, Bœotia, and some parts of the Morea, where the Albanians are regularly colonized, we have reason to believe, that when they are met with in other parts of Greece, it is only in small straggling parties, found there, perhaps, during the annual migratory expeditions of the shepherds with their flocks, or left behind them. After so many revolutions, what is called the Greek population of Greece cannot be unmixed. Many of the inhabitants of the mountains may be sprung from Albanians, or from other tribes distinguished in features and character from the inhabitants of the plains. And, in fact, Major Leake observes, that the Greeks of the mountain districts closely resemble the Albanians in manners and character. But, in a general view of the country, all those should be considered as Greeks who speak the language, and follow the national mode of worship, if they are not separated by some strongly marked distinction which prevents them from feeling an identity of interest with the great body of the Greeks in national questions. Considering the subject in this light, we think it may be assumed, that the Albanians are not more numerous in the other parts of Greece than the Greeks are in Albania; and making a rough estimate for the whole country, whether the smaller body is held to be one-fourth or one-sixth of the larger, in either case, the result will be nearly, that the Greeks are to the Albanians as three to two. On whatever principle we calculate, the Greeks can scarcely be made to exceed the entire mass of the other inhabitants, Turks, Albanians, Wallachians, Bulgarians, and Jews,* or one-half of a population of 2,700,000 souls. We have no data to authorize even a conjecture as to the number of Greeks in the parts beyond Mount Hæmus; but we think it is clear, from what has been stated, that the late Professor Carlyle proceeded upon a very exaggerated idea of their numbers, when he estimated the Greeks in the whole of European Turkey at 3,500,000.

But in Greece, as in other rude and ignorant countries, the most permanent ties, and the strongest antipathies, are grounded on religious distinctions. And the strength of the different religious parties is, therefore, a cue to the distribution of political interests. The Turks, who are all Mahometans, have already been estimated at 500,000. The Bulgarians, Wallachians, and Albanian colonists are Christians of the same denomination with the Greeks; and since neither the Jews, nor the Latin Christians, dispersed through the ports on the western coast, and in some of the Cyclades, are of any importance in point of numbers, we have only to estimate the proportion of Mahometans and Christians in Albania, to ascertain the total amount of each party in Greece. In southern Albania the native tribes are chiefly Christians; in the north chiefly Mahometans. Major Leake thinks, that the native inhabitants of Albania altogether (exclusive of Greeks) are pretty nearly equally divided between the two religions. On this ground, an addition must be made of 350,000, or 400,000, to the Turkish Mahometans, which will raise the whole number of Mahometans to 900,000. The different nations belonging to the Greek church, who constitute the remainder of the population, must, therefore, amount to nearly 1,800,000, or twice the number of Mahometans. It should be observed, however, that the Albanians were all originally Christians; that the party now professing Mahometanism embraced it only at a recent period, and are so lax in their faith, and so exempt from bigotry, as to be considered no better than infidels by the Turks. Their national temper predominates over their religion; and they hate the Turks much more than their brethren who profess Christianity. The two serve together in the army, and intermarry; and though the various tribes are often at feud with one another, religious differences are seldom the ground of their quarrels. If circumstances should, therefore, bring the Turks into danger, the tie of religion will be but a feeble bond between them and the Albanian Mahometans.†

Wallachians.

The Vlaki, or Wallachians, are next in numbers to the Greeks, Albanians, and Turks. Like the Albanians, they first appear in the history of Greece about the eleventh century. They are a tribe of mountaineers, chiefly employed as shepherds, living permanently on the great ridges of Pindus, and Olympus, and their branches; but, like the Albanians, descending into the plains of Thessaly, Macedonia, and Southern Greece, during the winter, with their flocks. They have a language of their own, which, from the great proportion of Latin words it contains, has led to a belief, that they are the descendants of the Roman colonies, planted in Mœsia and Dacia by the Emperor Trajan and his successors. The rugged country they inhabit has kept them unmixed with other tribes, and enabled them to maintain a considerable degree of independence. They are hardy, but less ferocious than the Albanians, sober, industrious, cleanly, and in high repute as shepherds throughout Greece, both for their fidelity and skill. Some of the higher classes go abroad as merchants, and the lower classes furnish some of the best artizans in Greece and Turkey at large; but wherever their occupations carry them, a strong national spirit recals them ultimately to their native mountains.

* Leake's *Researches*, p. 251, 254; Holland, p. 114, 253, 267; Hobhouse, p. 293, 490; Beaujour, Let. i.; Clarke, Vol. VII. p. 119, 408; Ib. Vol. VIII. p. 40; Pouqueville, Chap. v.—viii.

† Leake's *Researches*, p. 250; Hobhouse, Let. viii. ix. x. xii. xiii.; Holland, Chap. xxii.—xxiv.

Greece.

Within their own country they have considerable manufactures of coarse woollens. They are of the Greek church, and the men generally speak Romaic, or modern Greek, besides their own language, but the women know only the latter. *

Bulgarians.

The mountainous districts in the north of Macedonia are inhabited by Bulgarians, who occupy the whole region, from these parts to the Danube, and the neighbourhood of Constantinople. They are a people of Sclavonic origin, profess the Christian religion, and have a language distinct from that of the other people settled in Greece. They live chiefly by their flocks, are rude and ignorant, but brave. They possess only a small portion of the country at present; but for a considerable period between the eighth and eleventh centuries, they were masters of nearly the whole of Greece, and have left traces of their establishment there in the language, and in the names of places. †

Jews.

Small bodies of Jews are found in most of the considerable trading towns of Greece, engaged as usual in the lower branches of commerce. There are none in Athens, and this fact is accounted for, as in some other places, by the supposition, that the native Athenians outdo them in their favourite profession of usury. There is a considerable number in Janina; but they are nowhere so numerous as in Salonica, where they have been settled for some centuries. Their number in this city is estimated at 12,000; the peculiar privileges they enjoy, however, have not raised their character; for they are proverbially distinguished throughout Greece for chicanery, dishonesty, and immorality. Considered as a branch of the general population of the country, they are too inconsiderable to be of the least importance. Armenians are also found in some of the towns, but in a still smaller proportion than the Jews. ‡

Gipsies.

Bands of Tchinganies, or Gipsies, distinguished by the habits and occupations peculiar to them in other countries, wander over Greece. They are subjected, however, to the capitation-tax. Some of them make a profession of Mahometanism; but they are held in great contempt by the Turks. Some of the more wealthy Turks keep negro slaves, who are imported from Barbary and Egypt. §

Greek Church.

The Greek church appears at the present day covered with the accumulated abuses of ten or twelve centuries. It was founded in an age of theological casuistry and dogmatism; it has never felt the benign influence of general knowledge, or the salutary control of rival sects; but the bigotry or crooked policy of Christian princes, the barbarism of Mahometan conquerors, the pious frauds of monks or fanatical priests, the credulity and superstition of an ignorant populace operating uncontrolled, have been continually loading it with new errors, new absurdities, and new corruptions. Though its priests are more numerous than in any other church, its rites and forms infinitely complicated, and its fasts absorb about two-thirds of the year, it is scarcely possible to trace one genuine idea of Christianity in the minds either of the clergy or laity, or one trait of its influence in their conduct. The subtlety of understanding by which the Greeks are distinguished, and still more their proneness to superstition, have made them hold fast by their national faith amidst all the calamities they have suffered. And their barbarism has never yet been carried so far as to reduce the cumbrous machinery of their religion to any degree of simplicity.

Doctrines and Rites.

The Greek church agrees so closely with the Roman in its doctrines, and even in its forms, that it is rather difficult to discriminate them by any intelligible distinctions. The Greek church holds the doctrine of the Trinity, with some unimportant peculiarities. In the number of its sacraments, the invocation of saints, the belief of the real presence, the practice of auricular confession, and in admitting masses and services for the dead, it agrees perfectly with that of Rome. The sacrament of the Lord's Supper is administered to infants newly born, and, in the place of confirmation, they substitute the chrism or sacred unction, being a part or appendage of the baptismal ceremony. The sacrament of the Holy Oil, or Euchelaïon, is not confined, like the extreme unction of the Roman church, to the sick and dying, but is given to devout persons upon the slightest malady, or even in perfect health. On Holy Thursday, the Greek archbishop, like the Pope, washes the feet of twelve priests or monks. It is rather doubtful, whether the Greek church admits a purgatory, at least in the same sense as the Roman Catholics; and they themselves, at the present day, are too ignorant to be able to tell. The most palpable distinction between the two churches, in the eyes of the common people, is, that the Greeks abhor the images used by the Catholics, and employ only paintings in their churches. They have four liturgies, and the service, which consists chiefly of prayers, hymns, recitative chaunts, and frequent crossings, without any sermon, often occupies five or six hours. The want of seats in their churches, during the long service, is supplied by staves or crutches, which are used for leaning on, and form part of the church furniture. Their music is without instrumental accompaniments, but is allowed to have considerable beauty. The floor of the church is generally of earth, the altar of stone, the sanctuary separated from the nave by deal boards, and an inclosure of pales set off at the other end for the women. The church is generally in the form of a Greek cross. The choir is always placed towards the east, and the people turn their faces in that direction when they pray. The books of offices include biographies of saints, and are numerous and bulky. The clergy are distinguished by a great variety of striking vestments, to which many mystical virtues are ascribed. The Panagia, or Holy Virgin,

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* Leake's *Researches*, Chap. iii.; Holland, p. 226, &c.

† Leake, p. 375,—381; Pouqueville, Chap. xxxviii.

‡ Beaujour, Let. xxv.; Holland, p. 320; Chandler, Chap. xxv.

§ Holland, p. 266, 509; Pouqueville, p. 323.

has succeeded to the worship formerly paid to Minerva. There is scarcely a cottage in which her picture, with a lamp burning before it, is not seen in a wooden case, or a niche of the wall. The secular Greeks have four Lents, which are observed with various degrees of strictness, and the caloyers, or monks, have two more. The first of the secular fasts lasts two months, the second forty days, the third, which depends on moveable feasts, varies in its length, the fourth endures from the 1st of August to the festival of the Assumption. Every Wednesday is a fast, because it was on that day Judas received the money for betraying Christ; and every Friday in remembrance of the crucifixion. A vast number of saints' days are also observed, so that of the whole year there are only about a hundred and thirty days free of fasts or festivals. During these fasts the women are employed in gathering snails, and searching for herbs of different kinds. The change of food is enforced, without exception, on infants, old people, and the sick. Some of the festivals are celebrated in the open air during several days, with the firing of guns, songs, dancing, banquetting, and the most extravagant revelry. As confession generally takes place at these occasions, as a preparation, they are a harvest to the papades, who make a charge for absolution proportioned to the magnitude of the sin, and the supposed wealth of the sinner.

nks.

The Greek clergy are of two classes, the caloyers, or monks, and the papades, or priests. Monasteries, which are very numerous throughout Greece, are generally built in rocky and inaccessible situations for the sake of defence. They are supported partly by farms cultivated by lay brothers, partly by donations and perquisites received from the pious, partly by the exercise of mechanical trades, and the fabrication and sale of crosses, pictures of saints, psalters, &c. Their cells and prisons are universally dirty, as their minds are overrun with ignorance and superstition. In the vast establishment of Mount Athos, however, where five or six thousand monks are assembled, and in the monastery of the Apocalypse, in Patmos, there are seminaries where some slight theological studies are pursued. The patriarch of Constantinople, and all the superior Greek clergy, are generally taken from these places. Novices are admitted into monasteries so early as at ten or twelve years of age. The noviciate lasts two years, in the most regular monasteries; after which the novice changes his habit, and becomes one of the professed. The monks who distinguish themselves by superior sanctity may be advanced to a still higher class, called Megaleschemoi, who are thought worthy of being compared to angels. Their general diet is fish, pulse, roots, olives, and wine; during their fasts, which occupy nearly the whole year, pulse, roots, and water only. But, notwithstanding this mortified style of living, they are the sleekest and best fed people among the Greeks. Convents for women are rare. There are some anchorets who live three or four together, in houses depending on convents: and a few ascetics, who live solitarily in caves in the mountains. Convents of all kinds are under the superintendence of the bishop of the diocese. The expectations, long indulged, of finding some of the lost classics in the libraries of these establishments, have been at last entirely dissipated. Professor Carlyle examined the libraries of the whole twenty-two monasteries on Mount Athos, containing altogether 13,000 manuscripts, a greater number, certainly, than exists in all the other monasteries in Greece, and found not a single unedited fragment of any classical author. (Walpole, p. 196, 220.)

Secular Clergy.

The officiating clergy consist of two classes, the Patriarch, Archbishops, and Bishops, and Papades, or parish priests. All those of the first class are taken from the monasteries, and are not allowed to marry. The papades are allowed to marry once only previous to their consecration, but not afterwards. Hence, before entering into orders, they are generally careful to chuse healthy partners, who are likely to live many years. The superior clergy have some little learning, are generally decent in their characters, and attentive to the duties of their stations, which are numerous and difficult; as, besides having to control the licentious and fanatical priests, they are umpires in all disputes among those of their communion, and exercise an extensive civil authority under the Turks. They enjoy the title of δεσποτης, or Lord, and are treated with extraordinary reverence. They are, in fact, the princes of the Greeks at the present day; and hence the first families send their children to the monasteries of Athos or Patmos, on purpose to qualify them for these dignities. The Turks having reserved to themselves the investiture of the prelates, openly put the offices to sale, and hence the most indecent broils arise among the candidates. The patriarch of Constantinople, who rules the whole Greek church in European Turkey, and nominates all its inferior dignitaries, is said to pay sixty thousand crowns for his office. His income does not exceed L. 3000 *per annum*, and that of bishops, in general, L. 300. Dr Holland, however, was informed that the archbishop of Larissa had a revenue of L. 9000, but he doubts whether the amount was not exaggerated. The patriarch draws his revenue from contributions upon the archbishops and bishops, who are supported by a tax on each house within the dioceses inhabited by Greeks.

The inferior clergy are appointed Papades, or parish priests, by a species of parochial election, and before arriving at this office, they pass successively through the subordinate stations of reader, chanter, subdeacon, and deacon. No farther promotion, however, awaits them. Their means of living depend as much on their knavery as on their diligence in pastoral duty. They are supported chiefly by perquisites derived from absolutions, benedictions, exorcisms, sanctifying water, administering sacraments, selling amulets, sprinkling the streets and tombs, blessing the sea, granting divorces,—for most of which a certain price is fixed. The profits of excommunications, which are large in proportion to the terror they inspire among all classes, belong to the superior clergy, who alone have the power to issue them. By a shocking abuse of religious functions, the priests, when well paid, grant divorces at the instance of one party on the slightest pretence, and break the most sacred ties for a paltry bribe. Nearly all authors, who have alluded to the Greek

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priests, agree in describing them as the most depraved part of the population. They are coarse in their manners, and dirty in their persons, ignorant, greedy, and corrupt, and instead of cherishing virtuous habits in the people, they enervate and debase them, by practising on their credulity, and filling their minds with wretched superstitions, and perverted ideas of duty. It is not uncommon for them to lay aside the sacerdotal character, and become menial servants or public dancers, or to join bands of pirates or robbers. They are besides excessively numerous, and the people, who are extremely credulous and superstitious, are entirely under their influence. Athens, with 7000 or 8000 Christian inhabitants, has 200 churches, of which about 50 are used every Sunday, and the rest occasionally. (Wheler, p. 350.) In Albania the priests are much less numerous, and much less respected. In a word, the swarm of worthless priests is the moral pest of the country, and contributes more, perhaps, to keep the people in a state of ignorance and degradation than all the other evils in their condition.*

Antiquities. The antiquities of Greece open so wide a field, that, in an article of this kind, we can do nothing more than allude to the various classes of objects comprized under the title. Among these we may, without much impropriety, rank many of the cities themselves, which not only exist on the very spots they anciently occupied, and bear the same names, but deriving their most striking characters from natural objects, which remain unchanged, they still present to the eye, at a distance, the same general aspect and outlines. With regard to the interior of the cities, also, though the august temples of the gods have disappeared, and filth and meanness meet the eye everywhere, little doubt will remain with those who have read what the ancients have left us on the subject of their private houses, and what modern travellers have told us respecting the disinterred buildings of Pompeii, that the houses at the present day with their square enclosed courts, their projecting roofs, and dead walls, and all that is most peculiar in their plan and interior arrangements, are copies, though miserable copies, of those of the ancient Greeks; and it is probable that some of the modern dark and narrow streets of Athens come much nearer in appearance to what they were in the age of Pericles than the admirers of antiquity are willing to allow. Among the cities which occupy their ancient sites, and bear their ancient names with little alteration, may be mentioned, Athens, Thebes, Livadia, Larissa, Pharsalia, Salonica, Corinth, Argos, Nauplia, Patræ; and a great number of others of less note, might be added. The ancient buildings of which remains now exist belong to three different eras: 1. The very ancient structures to which the name of Cyclopian has been given, consisting of vast masses of unhewn stone, put together without cement. They are not numerous. The ruins of the citadels of Tyrins and Mycenæ, which are of this description, have remained in their present state for 3000 years, and present the most perfect specimen in existence of the military architecture of the heroic ages.† 2. The works of the classical ages, consisting of temples, baths, porticos, theatres, columns, stadia, fountains, which are extremely numerous, and executed in a great variety of styles, exemplifying the infancy, progress, perfection, and decline of the arts. Of the two or three hundred temples enumerated by Pausanias, many of which were models of the most exquisite beauty and symmetry, that of Theseus at Athens is the only one which is tolerably entire. Others are found in various stages of dilapidation; and the far greater part have vanished from their sites, and only left traces of their existence in their innumerable fragments of inscribed and sculptured marbles scattered over the fields, or stuck into the walls of forts, churches, and clay-built cottages. 3. A number of square towers, of a rude construction, built on the tops of hills for military purposes, are the only memorials left by the Latin princes who ruled Greece for two or three centuries before the Mahometan conquest. 4. Next in importance to the remains of ancient edifices we may rank the statues, bass-reliefs, and inscribed marbles; a great number of which, generally somewhat mutilated, have been brought from Greece to enrich the museums of western Europe; and a much greater number, no doubt, lie buried under the soil. 5. Vessels of Terra Cotta, or ancient pottery, consisting of vases, amphoræ, lamps, &c. of exquisite workmanship, adorned with coloured designs illustrative of the arts, habits, and mythology of the ancients, and often in high preservation. The quantity of these found among the ruins of ancient cities is incredibly great. 6. Coins of gold, silver, and copper, which are great in number and variety, every considerable town having its separate coinage. 7. Among the most interesting remains are the Tumuli, erected to commemorate great victories. These simple but expressive monuments, formed of conical mounds of earth, but long since divested of their sculptured ornaments, still mark the fields of Marathon, Leuctra, Platæa, Cheronæa, Thermopylæ, Pharsalia, and Pydna. 8. We ought also to class among the antiquities of Greece a vast number of fountains, caves, rocks, and other natural objects, which owe their interest, not to any beauty or importance they possess in themselves, but to the legends associated with them in the history and mythology of the ancient Greeks. With regard to the antiquities of Greece, in general, it may be observed that the finest, the best preserved, and the most numerous specimens of ancient art are found at Athens. Salonica, it is said, ranks next to it in this respect; but its monuments are deficient in the interest derived from classical associations. In general the southern and eastern parts of Greece, and the islands, abound most in an-

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* Tournefort, Let. iii.; *Constantinople, Ancient and Modern*, by James Dallaway, Sect. xxiv.; Pouqueville, Chap. xii.; Hobhouse, Let. xxxii.

† In Sir William Gell's *Itinerary of Argolis*, a good account of these remarkable ruins is given, illustrated by excellent drawings.

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Language. There are five languages spoken in Greece at the present day; 1. The Turkish, which is in use among a few of the Turks, but the great majority speak Romaic. 2. The Bulgarian, a dialect of Sclavonic, spoken by the tribes of Bulgarians who inhabit the northern parts of Macedonia. 3. The Wallachian, in use among the Vlaki, who occupy the branches of Pindus and Olympus, a language of uncertain root, but containing a large mixture of Latin and some Italian. 4. The Albanian or Shkipetaric, spoken by the natives of Albania, and by some of the colonies of this people in the south of Greece. It is an unwritten tongue, and abounds in nasal sounds. Its basis is supposed to be the ancient Illyrian, with which is intermixed a large proportion of Latin, and smaller proportions of Romaic, Sclavonic, Italian, and Turkish. 5. The Romaic (Ρωμαικη) or modern Greek, spoken by all the Greeks, by most of the Turks, and by a part of the Albanians. This is the name given to the language by the Greeks, who call themselves Ρωμαιοι, or Romans, a denomination derived from the establishment of the Roman empire for so many ages at Constantinople, which they consider as the capital of Greece. The ancient Greek they denominate (Ελληνικη) Hellenic, and their ancestors Ελληνες. The Romaic bears a much closer resemblance to the Hellenic than the Italian to the Latin; it adopts a great proportion of the Hellenic words unaltered, follows its inflexions and syntax to a considerable extent, and has, in truth, so strong an affinity to it, that Villoison, with some reason, considers it merely as a dialect of that language. The peculiarities which distinguish the Romaic from the ancient Greek cannot be fully explained without many details; we shall, therefore, only notice some of the most prominent. These are, 1. The disuse of the aspirates in speaking, though they are retained in writing. 2. The adoption of the first numeral *ενας μια ενα*, for an indefinite article, as in the French. 3. In substantives it discards the dual number, and the dative case, makes some alterations in the oblique cases, marks cases sometimes by prepositions, and often changes the Hellenic masculine and feminine into neuter. 4. The degrees of comparison are formed as of old, by adding *τερος* and *τατος*, but sometimes by *πλεον*, *plus*, as in the French. 5. Diminutives are much used as in the Italian. 6. Considerable changes and substitutions have been made in the tenses of the verbs, the infinitive and the middle voice have been suppressed, and two auxiliary verbs introduced, *θελω*, *I will*, and *εχω*, *I have*. 7. The Hellenic pronouns are retained, but with many modifications. 8. Some new words have been adopted from the Turkish, Latin, and Italian; others have been formed from Hellenic roots; and many old Hellenic words have changed their meaning; attributes being put for objects, and *vice versa*. The pronunciation of the Romaic deviates widely from that of the ancient Greek as taught in our schools. The Β is sounded like our V, while the place of B is supplied by *μπ*. The Δ is sounded like *th* in *that*, and *θ* like our *th* in *think*. The vowels *η*. *ι*. *υ*. and the diphthongs *ει*. *οι*. *υι*. are all pronounced like the Italian *i*. Great liberties are also taken with the orthography of the Romaic. Vowels are substituted for one another, and letters or syllables suppressed or added, according to the fancy of the writer, at the beginning or end of words. In addition to all this, there is a perplexing diversity in the style and construction. Those who write in Romaic, having no good models before them, readily fall into provincial vulgarisms; and as they often derive their ideas of composition from works in Hellenic, Italian, or French, they adopt, to a less or greater extent, the idioms of these languages. It is said, however, that the dialects of the spoken Romaic in Greece have not so marked a difference as those of the distant provinces of France or England. The purest dialects, or those which approach nearest to the Hellenic, are found in some of the least frequented islands of the Archipelago, in the mountainous parts of Greece, at Janina, and among the well-educated Greeks of Constantinople. The Romaic of Athens is full of corruptions, derived from the Italian and French; and the Athenians of modern times, though still distinguished for quickness and subtlety of understanding, are reproached by their countrymen with an indifference or want of capacity for literary pursuits. But in spite of the benumbing influence of Turkish despotism, a new impulse has been given to the minds of the Greeks; the Romaic is now in a state of progressive improvement, and both writers and readers are increasing. A great number of books, chiefly translations, have been printed in Romaic within the last fifty years; and at present there is not a Greek community, in a moderate state of opulence, which does not support a school for instructing their children in the ancient Greek, and often in other branches of polite education.†

Physiognomy, &c. There is a national likeness observable in all the Greeks, though, on the whole, the islanders are darker and of a stronger make than those on the mainland. They have a larger facial angle than the other nations in the south of Europe, to whom they are manifestly superior both in countenance and form. Their faces are just such as served for mo-

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* On the subject of the Antiquities of Greece, the reader may consult the following works: *Le Ruines des plus beaux Monumens de la Grece*, par M. Le Roy, fol. 1758. *The Antiquities of Athens*, by Stuart and Revett, 4 vols. fol. 1762,—1816. *The Ionian Antiquities*, by Chandler, Revett, and Pars, 2 vols. fol. 1769, --1797. *The Unedited Antiquities of Attica*, by the Society of Dilettanti, fol. 1817. Chandler and Clarke's *Travels*, already referred to; and Mr Edward Dodwell's *Classical and Topographical Tour in Greece*, 2 vols. 4to. 1819.

† Leake's *Researches*, Chap. i. The works published in Romaic have been chiefly printed at Vienna and Venice; a few at Moscow, Buda, Paris, and other towns. See a list of these works in Hobhouse's *Travels*, Chap. xxxiii. and Leake's *Researches*, p. 77.

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dels to the ancient sculptors, and their young men, in particular, are of that perfect beauty, which we should perhaps consider too soft and effeminate in those of the same age in our northern climate. Their eyes are large and dark; their eye-brows arched; their complexions are rather brown, but quite clear; and their cheeks and lips are tinged with a bright vermillion. The oval of their faces is regular, and all their features in perfect proportion.* Their hair, which is dark and long, is shaven off on the fore part of the crown and side of the face, and they wear a thin long mustachio on the upper lip. Beards are worn by the clergy, the Codja-bashees, and other men in authority. Their necks are long, but broad and firmly set, their chests wide and expanded, their waists rather slender. Their legs are strong and well made; their stature above the middling size; and they are muscular, but not brawny, nor inclined to corpulency. Both the face and form of the women are very inferior to those of the men. Though they have the same kind of features, their eyes are too languid, and their complexions too pale, and, even from the age of twelve, they have a flaccidity and looseness of person which is far from agreeable. They are generally rather below the middle size, and when between twenty-five and thirty, are commonly rather fat and unwieldy.

Dress.

The dress of Greeks of the wealthier classes closely resembles that of the Turks. A cotton shirt made like a woman's chemise, cotton drawers, a vest and jacket of silk or stuff, a pair of large loose trowsers drawn up a little above the ankle, and a short sock, make the inner part of their dress. Next above this is a long shawl, wrapped in wide folds round the loins; and a large gown or pelisse, with loose sleeves, forms the outer garment. The head is covered with a calpac instead of a turban. They wear slippers or quarter boots, which the privileged Greeks may have of a yellow colour, but even they are not permitted to wear robes of green,—the favourite colour of Mahomet. The common people have their trowsers descending but a little below the knee, with bare legs, and a slipper pointed and turned up at the toe. Above this they have a jacket, and on their heads the little red Albanian scull-cap.

The dress of the females approaches much nearer to that of the Frank ladies, and need not here be particularly described. That of the richer females is profusely ornamented with gold and silver trimmings. They wear bracelets of precious stones, and strings of gold coins round their arms and necks. They colour the inside of the eye-lashes with a composition, and use washes and paints to improve their complexion. With the young women it is a prevailing fashion to dye the hair of an auburn colour. When abroad, the Greek ladies are muffled up in a wrapping cloak, and wear a long veil, which, however, they frequently throw aside, when not in the presence of the Turks. They live almost as much secluded as the Turkish ladies. Indeed, before marriage, they are rarely seen by any male, except of their own family; and even the lover rarely sees his mistress till she become his bride. But afterwards the ladies enjoy the privilege of being introduced to people of their own nation, and to travellers. When, in the interior apartments, a young woman divests herself of her outer robes; and, in the summer season, may sometimes be surprised reclined on a rich carpet or sofa, with her feet bare, and her whole form rather shaded than concealed by trowsers of gauze, and a thin muslin cymarr.

Women.

The women can seldom read or write, but are all of them able to embroider very tastefully; and they can generally play on the Greek lute or rebeck. Their dancing they learn without a master from their companions; and their favourite national dance, the Romaika, is thought to bear a striking resemblance to the ancient Cretan dance, invented in the time of Theseus. Most of them are acquainted with a great number of songs or recitatives, accompanied with tales, which are combined and taken up by different individuals in succession for hours together. The Greek women evince a great quickness of understanding, and much aptitude for the acquisition of languages and other branches of education, when an opportunity offers. But their early marriages, for they are sometimes married at thirteen or fourteen, are prejudicial to their mental improvement. They are, however, assiduous housewives, and tender mothers, and, notwithstanding the scandalous imputations of some travellers, generally chaste. The state of bondage and seclusion in which they are kept naturally enfeebles their characters, and they are excessively credulous, weak, and superstitious, slaves to a thousand vain apprehensions, believing in sorcery and witchcraft; and receiving implicitly the dogmas and fables of their church. They are much guided by ominous dreams and celestial revelations; and at births, marriages, and other memorable domestic events, they have recourse to many spells and superstitious rites, to guard against fairies or wicked spirits. The evil eye is particularly dreaded; and the herb garlic is in high repute as a charm against this and other imaginary misfortunes. At funerals, women, hired for the purpose, accompany the bier, howling in a manner rather ludicrous than mournful, proclaiming the virtues of the deceased, and calling aloud to the corpse, "Why did you die? You had money, you had friends, you had a fair wife and children,—Why did you die?" On the ninth day after the funeral, the nearest relation gives a feast with music, dancing, and every other sort of merriment. Many of the rites and ceremonies now in use, and not a few of the observances connected with religion, have evidently been transmitted unaltered from Pagan antiquity. (Hobhouse, Let. xxxi.)

The Greeks affect a great deal of parade in their style of living. Those who are in office are addressed by pompous titles, keep great numbers of servants, dignified with the names of secretaries, physicians, couriers, &c. and have large houses, which are in ge-

* The manners and character of the Albanians, who form a considerable part of the population of Greece, are described in the article ALBANIA in this *Supplement*, to which the reader is referred.

Greece. neral shabbily furnished, and very dirty. Both Greeks and Turks contrive to support a respectable appearance with very slender means. The Greeks, like the Turks also, are all smokers, and addicted to the use of the hot bath. The men generally bathe once a week, the women at least once a month. Their diet, when not restricted by their fasts, consists, among the poorer classes, of bread made of barley, wheat, or Indian corn, pilau, or boiled rice mixed with butter, eggs, sheep's milk curdled, cheese made of sheep or goats' milk, dried fish, olives, gourds, melons, and various other vegetables. On holidays, lamb, mutton, kids' flesh, or fowls, are served up. The rich have a greater variety in their dishes and cookery. The mutton, which is the kind of animal food most in use, is seldom good, and is generally roasted or stewed, rarely boiled. Pastry is common, but is very indigestible, being sweetened with honey and not well baked. Boutaraga, caviar, and macaroni, are generally met with on the table, and a dish of snails is not uncommon. The bread is coarse and underbaked. Salted olives are a standing dish, and gourds and melons in their season. Great quantities of vegetables are consumed, such as cabbages, cauliflower, spinach, artichokes, &c. which are generally prepared with oil or butter, and seasoned with pepper, mint, marjoram. Oranges, pears, olives, citrons, medlars, pomegranates, are served up as a dessert. During dinner the Greeks drink wine and a spirit made from barley, resembling whisky; but they rarely indulge to excess. Coffee is much in use, but is taken rather as a refreshment than as a part of diet. In general, says Dr Holland, the Greeks have an appearance of comfort in their dwellings, clothing, and in the various habits of life, not much inferior to that of other nations in the south of Europe.*

Travellers seem now to be nearly agreed as to the intellectual and moral qualities of the Greeks. It is allowed that they have much acuteness of understanding, polished and agreeable manners, a sprightly wit, and great natural eloquence; but, on the other hand, their apologists cannot deny that, though strict in their fasts, they are lax in their morals; that their vanity forms a lamentable contrast with their humbled condition; and that they have more than an ordinary share of duplicity, meanness, and bigotry.

A great proportion of the Greeks are engaged in foreign or domestic trade; and as merchants they are reported to be vigilant and dexterous, but overreaching and deceitful. Those who get into power, as Archons or Codjabashees, are as rapacious and tyrannical as the Turks. All classes are devoutly attached to the doctrines of the church, and hold other sects in such contempt, that they regard themselves and the Russians as the only Christians. The few well-informed men among them are generally sceptical, as will always happen where religion is debased by absurdities which shock the understanding. One of the best features in their character is the strong national spirit that animates them, and the lively interest they take in the fate of their country. The Greeks settled in Russia and Italy, and some of those at Constantinople, have expended a considerable part of their fortunes in supporting schools, and in printing works designed to enlighten their countrymen. Their sensibility on this subject is, indeed, extraordinary. Mr Hobhouse informs us that, on mentioning the name of Riga (who was put to death by the Turks for exciting his countrymen to a revolution) to a young Greek of high rank, he jumped up from the sofa, and, clasping his hands, repeated the name of the patriot with a thousand passionate exclamations, the tears streaming down his cheeks. They continually reproach the Franks with ingratitude, for not assisting them to throw off the Turkish yoke; asserting that we are indebted to their ancestors for all the arts and knowledge we possess. Yet, though the deeds of the ancient Greeks live in their memories, and are often in their mouths, they have a very confused and erroneous idea of their character. They associate the glory of their ancestors much more with the empire of Constantine and his successors, than with the Greek republics. And their bigotry has so far perverted their ambition, that the overthrow of the Turks would gratify them more as the triumph of their church than as the establishment of their independence. In private life, the Greeks have much social feeling; and, though easy in their manners, are strict observers of forms. Two men, in saluting, first touch their foreheads, then place their right hand on their hearts, and kiss each other. They make the most ceremonious and particular inquiries after each other's families. It is rare to find a Greek living single, except as a widower, for they seldom marry a second time. They are fond of titles and distinctions, in proportion to their want of real strength and dignity of character. Every Archon and Codjabashee, though he has but the shadow of official dignity, is "most illustrious," or "most noble." A Bishop is styled "your Beatitude," a priest "your Holiness." They are avaricious, but they desire money only for the purpose of ostentation. Their veneration for wealth indeed supersedes, in some measure, the strongest natural ties. Children who get rich sometimes employ their own fathers as menial servants, and are waited upon by them at table. Parents teach their children to kiss their hands, and to address them by the title of Signor, which implies superiority, and is, therefore, preferred to more endearing appellations. All classes, but especially the lower, are lively and gay, excessively fond of dancing, music, and pastimes. They delight in poetry, and have a remarkable facility in versifying. Of popular songs they have a great variety relating to love and drinking; some of them written by living authors who have distinguished themselves in this species of composition. They have also some pieces of a greater length and of a dramatic form. Their music, which is plaintive but monotonous, is sung with a nasal tone. The fiddle and three-stringed guitar

* Hobhouse, 226; Pouqueville, Chap. xv.; Holland, 268.

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are the instruments most in use. Strolling bards, still bearing the ancient name of Rhapsodists, frequent the houses of the wealthy, singing love songs, or celebrating in rude verse the exploits of some warrior, and accompanying their voices with the lyre. Foot races, wrestling, and the disc, are still, as in ancient times, favourite amusements. The Greeks are rarely employed in any military capacity, but they are allowed to be not deficient in courage, though they are easily discouraged by difficulties, and certainly want the constitutional firmness of the Albanians.*

The Greeks of the present day, though unquestionably much debased, are rather objects of compassionate sympathy than indignation. The cardinal vices of their character, dissimulation, meanness, and superstition, are so distinctly referable to their political situation, as to warrant a belief that a favourable change in the one would speedily be followed by an improvement in the other. Experience tells us that misery and persecution increase men's attachment to their religion; and that, among a people so attached to their religion, possessing lively imaginations, but grossly ignorant, and where the only pittance of knowledge to be found is in the hands of priests, superstition must take root and flourish; and when we recollect that the national faith of the Greeks, rendered venerable in their eyes by its antiquity, has descended through a period of fifteen centuries, exposed to the continual action of all the causes that could corrupt it, without one lucid interval of free inquiry, and diffused knowledge, we cannot be surprised that the vital principles of religion have totally disappeared amidst the rubbish of senseless forms, mystical rites, and vain pageantry. Again, with regard to the civil condition of the Greeks, it may be observed, that the slavery in which they are held is of the most demoralizing kind. Uninstructed though they be, they are enlightened compared with the Turks. But knowledge, when doomed to dependence on ignorance and rudeness, unavoidably degenerates into craft and duplicity. Instead of raising the character of the individual, it furnishes him with new powers of servility and deceit, and makes him more deeply conscious of the ignominy of his condition. A human being can never feel his self-degradation so complete as when he is the slave of another whom he despises. What is still worse in the state of the Greeks, the lord and vassal are separated by difference of faith; and the rancour of religious bigotry inflames the contempt and hatred naturally generated between the oppressor and the oppressed. Human nature, in such painful circumstances, has but two resources—resistance at the hazard of extermination, or entire submission. The suffering party must either bend to its hard destiny, and endeavour by flattery, duplicity, and management, to mollify the violence of the oppressor, and by cunning and dissimulation to elude his tyranny; or it must assume a courage from despair, and extort better terms by the obstinacy of its resistance. The Jews, the most degraded portion of European society, illustrate the one case; the Albanians the other. Though too many of the Greeks have chosen the less honourable alternative, and have sunk to a state of abasement resembling that of the Jews, they have also shown themselves capable of acting the more rugged and difficult part when favoured by circumstances. The inhabitants of the hilly country have everywhere forced the Turks to respect their privileges; and the firm and unconquerable spirit displayed by the Mainotes of the Morea, and the Suliote Greeks, in defence of their rights, is worthy of the most brilliant days of Sparta or Rome. Doubts have been raised unnecessarily whether these people are of the same race with the Greeks of the plains. Both, however, have the same language and religion, and their manners do not differ farther than local circumstances are sufficient to account for. We see the influence of the same causes exemplified in the Albanians who have settled in the low country; for these have lost the high and resolute spirit which distinguishes their countrymen, and submit to be insulted and pillaged by the Turks like their neighbours the Greeks.

Question as to the Emancipation of the Greeks.

The question regarding the emancipation of the Greeks from the Turkish yoke involves so many collateral topics, that a long dissertation would be required to do justice to it; and we can only spare room for a few remarks. First, we may observe, that the moral degradation of the Greeks is not necessarily fatal to their hopes of deliverance. A sense of common interest, a strong national spirit, and a powerful feeling of revenge, are the motives that excite men to act in such circumstances; and all these the Greeks feel the influence of in a considerable degree. They have courage; and though they want the private virtue and disinterested public zeal necessary to build up a free government, it should be recollected that they may be independent without enjoying civil liberty, and yet by such independence their condition would be immensely improved. In the second place, while the Turks are remaining stationary, the Greeks are silently advancing in knowledge, in wealth, in numbers, and in the consciousness of power; and their relative situation is thus daily improving. Their lively and susceptible disposition is extremely capable of every species of instruction; and all the arts and knowledge of western Europe, with all the superiority which these confer, could be communicated to them more easily than to any other people in the same stage of civilization. In the third place, the power of the Turks seems verging to destruction, from the craziness incident to an old system, which has no means of internal renovation, and no power to adapt itself to the changed circumstances of Europe. Their numerous defeats have destroyed their confidence in themselves. They form but a fraction of the population of Greece; and though they are accustomed to

* Hobhouse, Let. xxxi. xxxiv.; Pouqueville, Chap. xi.; Beaujour, Let. xxv.; *Notes to Childe Harold*, Canto II

command, and have the machinery of government in their hands, their force is badly organised, and their torpidity and want of skill neutralize the power they have. In the fourth place, Greece is a mountainous country, abounding in strong positions; and therefore affording great advantages to a population engaged in desultory warfare. To this we may add, that, in the event of a general insurrection, the commercial marine of the Greeks would soon render them masters by sea; and, from the nature of the country, this would operate powerfully in their favour.

There cannot remain a doubt, therefore, that a very slight effort would be sufficient to subvert the Turkish power. But the emancipation of the Greeks depends, in some degree, upon a variety of other circumstances. First, Greece is unfortunately occupied by several nations, differing in manners, language, and origin, who have no common ties sufficient to unite them firmly together. Setting aside the Bulgarians, who are posted at the extremity of the country, and the Turks as the common enemies of the whole, there are still the Wallachians, who have entire possession of a considerable district, besides being dispersed in small portions through the rest of the country; and the Albanians, formidable by their numbers and energy, masters of two-fifths of the country, and spread in a small proportion through the whole. These nations, with the Turks, form about one-half of the population. The Greeks, who form the other half, are thus every where mixed with their rivals or their enemies. The Wallachians, though professing the same religion with the Greeks, differ from them in manners and language. The Albanians are not only distinct in manners and language, but regard the Greeks with contempt. Even among the Greeks themselves there are considerable diversities of character. The commercial Greeks of the towns have probably but little affinity with the peasantry, and the Mainotes of the Morea as little with the peasantry of Thessaly and Macedon. All these parties agree in hating the Turks; but, it is evident, there are many antipathies to be removed, and rival interests to be reconciled, before they can be brought to co-operate vigorously in a common design. Should the Greeks move by themselves, they will find that all who are not for them are against them; and the Turks, with the usual policy of despotic rulers, will make use of one party to crush the other. But, in the second place, the consolidation of so great a part of Greece under the Pasha of Albania, has given an entirely new aspect to the question regarding the emancipation of the Greeks. Albania, for some centuries, has been divided among a number of fierce and warlike tribes or clans, almost independent of the Turks, but engaged in perpetual contests with one another. The union of these hostile tribes, for the first time, under one head by the vigour of Ali, has necessarily raised up a new and formidable power, which must make itself felt in all the surrounding parts. It is so formidable, indeed, that no great change can now take place in Greece without its concurrence. The two great parties of Greeks and Albanians are, in fact, so placed that their union is essential to the independence of the country, and that union seems to be scarcely possible. So long as Ali wants the naval means of the Greeks, and while the Turks occupy the southern and eastern part of the country, his power cannot be secure. The two nations are too strongly divided by dissimilarity of character and mutual antipathies to coalesce voluntarily. Nor is it probable that the Albanians, who are stronger for defence than conquest, will be able to reduce Southern Greece by force. The Greeks, on the other hand, would not make any effort for the sake of exchanging the sluggish tyranny of the Turks for the rigorous despotism of the Pasha. Were they to attempt to liberate themselves, Ali's sagacity would teach him to regard such a step as injurious to his interest; for, though it would weaken the common enemy the Turks, it would raise up a new power much more formidable to him. To all appearance, therefore, the power of the Turks in Greece, so far as depends on these causes, may maintain itself some time longer, by means of the mutual jealousies of its domestic enemies.

The Greeks, however, have long looked to foreign aid for the means of liberating themselves; and three different opinions prevailed among them recently in relation to this subject. The insular and commercial Greeks, and those of the Morea, attached themselves to the idea of liberation through England; a second party, including many of their literary men and continental merchants, looked to the late revolutionary government of France as a more probable means of deliverance; while the lower orders, and those most attached to the national religion, were anxious to receive the Russians as liberators. (Holland, 274.) The recent course of events has certainly lessened the probability of any of these powers interfering in their favour. While the dread of jacobinism continues to haunt the princes of Europe, they will be little disposed to tamper with new revolutions, or schemes for reviving Greek republics. The Greeks have more to hope from the popular spirit now spreading through all the western parts of Europe; but their chief reliance ought to be on their own efforts to spread education and knowledge among themselves, to raise their national character, and to create a common interest in national objects.

In the course of last century, the Greeks made two unsuccessful attempts to liberate themselves. The first was in 1770, during a war between Russia and the Porte. The Russians, in pursuance of a plan previously concerted, landed a small force of 2000 men at various points in the Morea. The Mainotes, and other Greeks, rose in arms instantaneously, and got possession of the open towns, butchering the Turks with every circumstance of cruelty. Before, however, they had mastered any of the fortified places, a great force of Albanians pouring in, defeated them, and retaliated, with dreadful severity, the cruelties committed on the Turks. The inhabitants of some entire towns and villages were massacred, and the country almost desolated. Though the Greeks acted with much vigour at the outset, it was observed that their spirits sank at the first check they received. But it is impossible

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to reprobate too strongly the cruelty and perfidy of the Russian government, which, by sending such an inadequate force, exposed the Greeks to certain destruction, for the sake of making a paltry diversion in its own favour; and, at the conclusion of a peace, took no effectual means to protect them from the rage of their enemies.

In 1790, the Greeks of Suli, in Albania, rose in arms, upon an understanding that assistance was to be received from Russia. A deputation went to Petersburg to offer the crown of Greece to Prince Constantine, brother of the present Emperor, whom they saluted βασιλευς των 'Ελληνων. They were to collect their various troops from Suli, Livadia, Attica, and the Morea,—to march through Thessaly and Macedonia, where they were to be joined by other reinforcements, and to meet the Russians at Adrianople with 300,000 men (as they gave out), after which the combined army was to proceed to Constantinople, and drive the Turks out of Europe. In the end little was done. The Russians sent a trifling sum of money, which was chiefly embezzled by their own agents, and soon made peace, without concerning themselves about the peril into which they had brought the Greeks. The Suliotes defeated the Pacha of Janina, and, aided by their rocks, defended themselves with prodigies of valour against the Albanian Turks. A squadron of twelve small vessels, which they had fitted out at Trieste, signalized itself in the Archipelago, and after spreading terror among the Turks, was overpowered and destroyed by a greatly superior force. This second enterprise, in short, ended like the first, without any other effect than that of exposing the Greeks to renewed outrages from the Turks. The brave tribe of the Suliotes, on whom the Greeks placed a great reliance, as the best soldiers of their faith, were totally destroyed by Ali in 1803, after a contest of many years.*

(B. B. B.)

Boundaries and Extent.

GUATIMALA, Goetemala, or, as it is sometimes called, Gualtimala, is an extensive dominion of Spain, in North America, lying between the Carribean Sea and the Pacific Ocean, and abounding with rivers, which empty themselves into both seas. It is about 750 miles in length, on the frontier towards the Pacific Ocean; but, on account of the various indentations, the extent of coast it presents to the Carribean Sea is nearly twice as long. Its breadth varies very considerably, being in some parts not more than seventy miles, and in others exceeding four hundred. Its western boundary is the river Huasaculco, which runs to the Gulf of Mexico; and a line drawn from the source of that river due south to the bay of Tecoantepec. These limits divide it from the province of Oaxaca, in Mexico. It is divided, on its eastern frontier, from the provinces of Veragua and Costa-rica, in the viceroyalty of New Granada, by a line beginning a little to the eastward of Carthago, and terminating at the head of Golfo Dolce, in the Pacific Ocean. As the whole country is an isthmus, its other boundaries are the two seas which have already been stated to wash its shores.

Government and Population.

This territory is called a Captain-Generalship, as distinguishing it from a Viceroyalty, which, though it gives to the delegated governor a higher title, confers no greater degree of authority. The Captain-general of Guatimala is commander of the army, the navy, the revenue, and police; and the same system of government prevails as in the other Spanish dominions, as is described under the article Granada, New. The inhabitants are the same classes as are there noted, with a small variation in their relative numbers. The Indians who live in their own towns are mixed with Europeans, and more numerous than in any other Spanish province; and the number of the mixed races less. There are few negro slaves; nor do the white Creoles bear so large a proportion to the whole number of inhabitants as in the viceroyalty of New Granada. The European settlers, on the other hand, are a more numerous body, in proportion to the whole. The total number of inhabitants which people this extensive country, on a surface of 26,150 square leagues, amounts, according to the most accurate calculation, to about 1,350,000. Thus the human beings do not amount to more than one to each eleven hundred acres of land. In the more populous countries of Europe, such as England, France, and Belgium, the average rate may be estimated at one person to four acres; thus maintaining a density of population, when compared with Guatimala, as 270 to 1. If the whole of Guatimala were as well peopled as England, it would contain more than 36,000,000 of human beings; and, as the nature of its productions is such as to afford a greater portion of food, according to the extent of the land, than any European soil; and farther, as the cultivation of the soil would improve the climate, the population, at some distant period, may very far outnumber the proportion which exists in any part of the ancient world.

Face of the Country, Climate, &c.

Guatimala, like the other possessions of Spain in North America, is forbid, by the scarcity of harbours, and the impediments at the mouths of its various broad and deep navigable rivers, from becoming a country of extensive commerce. It does not possess, either in the Carribean Sea or in the Pacific Ocean, a port capable of receiving a large ship; and hence there is no other than a coasting trade, by which some of its surplus produce is disposed of to the neighbouring colonies. This circumstance has been a check to cultivation, and prevented that increase of wealth which other provinces have experienced. The face of the country, generally speaking, is covered with mountains; none of which, however, are so high as to enter the regions of perpetual frost

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* For a more detailed account of these two insurrections, the reader may consult Eton's *Survey*, and the *Annual Register* for 1770.

and snow. We are very imperfectly acquainted both with their directions and elevations. A chain of mountains runs through the provinces of Veragua and Nicaragua ; but, whether they are disjointed and broken, as the course of the rivers would indicate, or form a continuous cordillera, has not yet been accurately investigated. The vallies between them enjoy a rich soil, and produce, with little effort, all the tropical fruits in full perfection. The sides of the mountains yield excellent wheat, barley, and the other grains of Europe, whilst vast plains are covered with cattle, in almost a state of nature. The principal food of the inhabitants, however, is maize; and as it is of all crops the most fluctuating in its produce, sometimes a considerable surplus is afforded; and, at other seasons, scarcity, and even famine, are felt.

Guatimala is more visited by earthquakes, and abounds more in volcanos, than any other portion of the American continent. The volcanos are, in general, in a state of eruption ; but, when the eruptions are suspended in any of them, the inhabitants consider it an indication of earthquakes, and usually find themselves soon afflicted by those visitations.

The climate, on the eastern side of Guatimala, is generally unhealthy ; the inhabitants are much afflicted with intermittent and bilious fevers, and very much subject to fluxes; but, on the coast of the South Sea, the climate is more salubrious ; as, indeed, is is throughout the whole extent of America. On the coasts of Guatimala, in the Pacific Ocean, they are subject to continual storms of wind, accompanied with deluges of rain, in the months of August, September, and October ; and, in January and February, they are visited by most tremendous hurricanes from the north-east, and from the east-north-east. The humidity of the atmosphere, during the first of those periods, is not considered injurious to health ; but that, and the tempests in the latter period, alike render the coasts inaccessible, or at least highly perilous, to all shipping.

Costa-rica, the southernmost province of Guatimala, adjoins the province of Veragua, in the viceroyalty of New Granada ; it is about 150 miles in length, and in breadth about 140 miles. It derived its name from the rich mines which the first discoverers imagined to exist in it, but their expectations have not been realized. Some gold is found, but only by washing the sands in the mountain torrents. A very rich silver mine, called Tisingal, is worked, though, from the scarcity of labourers, the want of capital felt by the adventurers, and the inhospitable country in which it is situated, its product is but small. It is, however, reported to be equal in richness of ore, and in extent of veins, to the celebrated mine of Potosi in Peru, but the sanguine reports of the proprietors have been insufficient to draw to it the requisite capital and labour.

The whole province is mountainous, and covered in most parts with thick forests, and its agriculture is very inconsiderable. The far greater portion of the inhabitants are the Indian tribes, who, though subject to Spain, and reduced under her religion, live in their own towns under the government of the native chiefs, who account to the Alcaldi, appointed by the Captain-General, for the tribute exacted from them, and for their obedience to the laws.

Cartago, the capital of the province, is called a city, but though the residence of the governor, and a bishop's see, it does not now contain, from having much declined of late, more than two thousand souls. It is distant from the Carribean Sea, and from the port of the same name, about thirty miles. A very inconsiderable trade is carried on by small craft with Chagre and Portobello ; its exports consist partly of dried meat and hides, and some honey and bees'-wax, the latter of which are produced in large quantities. Nicoya, the only other town, is near the Pacific Ocean in a bay of that name. It is more populous and more healthy than Cartago, and carries on a coasting trade with Panama, to which place it sends wheat, maize, salt, honey, wax, and some cocoa, and receives in return the few productions of Europe which it demands.

Nicaragua, the next province to Costa-rica, is extended along the Pacific Ocean, approaching only to the Carribean Sea, or a small part of its eastern extremity. The most remarkable feature of this province is the beautiful lake, which occupies a large portion of its western side. The lake of Nicaragua is about two hundred miles in length, and one hundred and sixty in breadth at the middle, which is the widest part. The depth of water is generally about forty fathoms. It is interspersed with some beautiful islands, and its navigation affords great facilities to the communication between different parts of the province. This lake is worthy of notice, as being, perhaps, the easiest way by which a communication could be opened between the Gulf of Mexico and the Pacific Ocean ; a communication by which the intercourse and commerce of Europe with the western side of America, and with Asia, would be greatly facilitated. This project has often been contemplated, but, probably for political reasons, has not been put in execution, by Spain, the only power that could effect it. By the river St Juan, which runs into the Carribean Sea, vessels drawing eight or nine feet water frequently pass from the lake of Nicaragua to Chagre, to Portobello, and to Port Omoa. It is indeed only during the rainy season that vessels of such a draft can pass, but it is at all times navigable by canoes and large boats. Towards the latter part of the American war, General Dalling, then Governor of Jamaica, equipped an expedition for the purpose of taking possession of the entrance to this lake. Two men, afterwards distinguished, though in very different ways, were employed in it. Nelson, the great commander, then a lieutenant, was with the naval part, and Colonel Despard, afterwards executed for a silly but treasonable plot, conducted the land forces. They had considerable aid from some of the Musquito Indians, who, as soon as they had entered the river St Juan, assisted in tracking the boats in which the troops and stores were embarked. Having ascended about seventy miles, the expedition was interrupted by the fort of St Bartholomew, which, however, after some opposition, was taken. As they proceeded, the rain being incessant, the men became sickly, and a flux destroyed several. The great number of Indians that accompanied the expedition, though useful as guides and as towers, were found an incumbrance when provisions began to grow scarce.

The inhabitants removed whatever aliment they could; and the want of food, and the increase of sickness, at length compelled the adventurers to return to their ships, which they effected, though not without the loss of nearly half their men. The result of this expedition, however disastrous, has proved the possibility of ascending to this great lake. Some obstacles to complete navigation exist, which might be easily removed. The lake is navigable for vessels of the largest size to its western shore, where it is separated from the Pacific Ocean by an isthmus not more than fourteen or fifteen miles across. The nature of this isthmus is not very accurately ascertained; but some travellers have asserted that it is nearly level in many parts, and that channels in which streams already run, demonstrate the practicability of cutting a canal, which would accomplish this great object. It is clear, from the current of the river St Juan, that the lake of Nicaragua is higher than the Carribean Sea. Whether the level of the Carribean Sea is higher than the Pacific, is a problem yet unsolved; but be that as it may, there can scarcely be a doubt that if a channel was once opened, the impetus with which the trade winds drive the water towards the Gulf of Mexico, would increase any opening that was once made, and in a short period give sufficient passage to a vast body of water. On the eastern side of the isthmus the tide does not rise more than twelve or fourteen inches, whilst on the western shore it rises from fourteen to sixteen feet.

The climate of this province is generally healthy, the soil is fruitful, and the aspect of the country so pleasing, that the first discoverers denominated it "El paraiso de Mahomo," or Mahomet's paradise. The air is perfumed with odoriferous plants, there is a constant verdure, from the moisture of the climate, and the greatest profusion of beautiful flowers.

Its vegetable productions are hemp, flax, cotton, sugar, with dyeing and medicinal woods and gums. Its mines produce some silver, but the working of them is not very extensive. A small quantity of gold is found by washing in the rivers; but the mineral productions are of trifling importance. The inhabitants increase rapidly, and have some few manufactures; the most celebrated goldsmiths and jewellers of America are said to reside here.

The city of Leon, containing a population of about 6000 souls, is the capital of the province. It is on the side of a fresh water lake of its own name, to the north-west of the lake of Nicaragua. It is the see of a bishop, and has some handsome churches and convents. It is not a place of much commerce, being removed from the sea. The nearest port is Realejo, on the Pacific Ocean, from whence its exports for Panama are shipped. The river Realejo is capable of containing large fleets, but, having a bar, it is difficult of entrance, even for the small vessels that carry on the trade of the western sides of America. Pitch, tar, and cordage, are sent from it to Panama, and sometimes even to Guyaquil.

Granada, sometimes called Nicaragua, is the town of next importance. It is at the south-east extremity of the lake, and depends principally for its prosperity on the intercourse it maintains by the lake with the other parts of the province. The nopal plants in the vicinity of this city furnish some cochineal, but it is inferior to that produced in the province of Oaxaca in Mexico. The only other town of note is St Juan, at the mouth of the river of that name, which runs from the lake to the eastern sea. It is a small place, mostly inhabited by Indians, and very unhealthy.

Honduras.

The province of Honduras, to the northward and westward of Nicaragua, is 390 miles in length, and 150 in its greatest breadth. On its eastern and northern side it is bounded by the Carribean Sea, to which it presents a front of low and marshy land, intersected with innumerable streams, which communicate a humidity to the atmosphere highly prejudicial to human life.

Though the coast is generally unhealthy, and the soil, though luxuriant, scarcely cultivated, yet, in the interior of the province, where the land gradually rises to hills, and thence to mountains, the agriculture is considerable and the soil highly fertile. On some of the more elevated spots wheat and other European grains are raised. Maize is most abundant, yielding three harvests in the year, and vines are cultivated, which produce fruit twice in the year. Black cattle and sheep are abundant. Honey and bees-wax are furnished in considerable quantities. The most abundant produce, however, is that of mahogany, logwood, and other dyeing drugs, and these, indeed, compose almost the whole of its exportable commodities. Mines, both of gold and of silver, exist in this province, but they are worked to a very inconsiderable extent. The number of inhabitants is by no means proportioned to the extent of the province. Many of the Indian tribes which compose its population are not only independent but even hostile to the Spaniards, and are maintained in that hostility by their intercourse with the English settlers, who occupy a small part of the province. The principal town on the Spanish part is Comyaguas, or, as it is sometimes called, Valladolid. It is the seat of the governor and the see of a bishop, and, though situated on a river which runs to the Bay of Honduras, enjoys but little commerce. It inhabitants are not more than 3500, and mostly Indians. Truxillo is a town in a bay of the same name, and of considerable importance. Its commerce has increased during the wars of Europe, from the intercourse between the United States of America, and the whole captain-generalship of Guatimala, having been carried on here. Its situation was favourable for contraband trade, the wants of the interior were increased by the long duration of the war, some understanding probably existed between the governor, the officers of revenue, and the Northern Americans, and hence this city has been increased and enriched considerably.

St Francisco de Omoa is a town, with a well fortified castle, on the sea coast near Truxillo. It has been considered the key of Honduras. The silver from the mines used to be deposited here to be transported to Europe, and it was the principal depôt for the quicksilver which was required for producing the silver. The legal trade from Guatimala centered here, but, during the war, the contraband transac-

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tions at Truxillo very far exceeded the lawful commerce, and whilst one place has been increasing the other has diminished. Omoa, too, has been considered less a place of safety than it was formerly held to be. When the war broke out between Spain and England in 1779, a small expedition of two frigates sailed from Jamaica to attack it, and, by a *coup de main*, took possession of the fort, with all the treasure it contained, amounting, in bars of silver, in dollars, and in quicksilver, to more than a million of piastres.

Gracias A Dios, another town in the Bay of Honduras, has some commerce, chiefly the export of mahogany and logwood, but the recent wars have injured its trade very materially, and it has gradually gone to decay.

British Settlement on River Balize.

The British settlement within this province deserves to be noticed, and may be properly introduced here. It is on the river Balize, which runs a considerable distance through the country, and is navigated by boats more than 200 miles from its mouth. The town contains not more than 1200 inhabitants. It has always a small garrison of regular troops to defend the entrance of the river.

The English have always claimed a right to the whole of what is called the Muskito shore, and have, at various times, held and relinquished different settlements on its borders; but, of late, their possessions have been confined almost exclusively to the river Balize. The entrance to this river is peculiarly dangerous, from being surrounded with shoals and quicksands, and from the coast being very frequently enveloped in fogs. The ships that carry on the trade are the worst description of vessels that sail from Great Britain, and the loss by shipwreck greater than in any other department of her commerce. The most valuable production of the British settlement, and that which is the principal inducement to maintain it, is mahogany, which grows here to a large size. The felling of these trees is performed by negro slaves, who, in gangs, with a leader called the Finder, penetrate into the thickest of the woods, ascend the lofty trees, and spy out the mahogany. These trees are much dispersed, but are known at a distance by the excessive deep green of their leaves. The tree is generally cut at about ten feet from the ground; the trunks are the most valuable part from their size adapting them to tables, and larger articles of furniture; but the wood in the branches is more richly veined, and more beautiful. The far greater part of the expence of obtaining mahogany is in the labour of conveying the wood from the place of its growth to the river side; after it is once there, the cost of conveying it to the ships, though sometimes at 200 miles distance, is but small. Logwood is another production of this settlement. This tree grows very rapidly, so as to be in a state fit for the purposes of the dyer at the end of five years. The trees are usually, on the spot of their growth, cut into logs about three feet long; and in that state conveyed to Europe, and used for dyeing the most beautiful purple and black colours. Another branch of industry of some importance is the turtle fishery, which is carried on to a considerable extent by the British settlers on this coast. Many of the green turtle taken here are sent to Jamaica, and many furnish banquets for the richer inhabitants of our capital, and our larger sea-port towns. The hawksbill turtles are likewise taken here; the flesh is sometimes eaten by the black colonists; but the principal value is derived from the shell, well known by the common name of tortoise-shell, the export of which is considerable. The attention of the settlers is too much engrossed by their peculiar pursuits, to devote much application to agriculture; but the soil is excessively fertile, and, with little labour, produces all the tropical fruits and vegetables in abundance, especially plantains, bannanas, and maize.

Musquito Indians.

We have before mentioned the Musquito Indians. Though usually denominated by that appellation, they are not indigenous, and therefore not entitled to the name of Indians. They are evidently of African origin, as their woolly heads and thick lips demonstrate. The traditionary history of these tribes is, that, in a ship from Africa, the male and female slaves rose on the mariners, and murdered them all; that, not understanding the art of navigation, they were driven by the trade-winds to leeward of all the islands, and at length landed on this coast, where they increased and peopled the country. It is not clearly ascertained at what time this event occurred; but for one hundred and ten years the British have had connections with them, and they have obtained a kind of superiority, which, however, principally consists in the nominal command being conferred on one of their chiefs, by a commission from the Governor of Jamaica. The Spaniards, in their vicinity, when they approached, wished to subject them to their regulations, the resistance to which produced cruel wars, far from being yet terminated. These Musquitos took refuge in the mountains, till they had opportunities of intercourse with the British, from whom they obtained fire-arms. They were then, with the help of these allies, sufficiently powerful to resist the Spaniards, and to keep open the intercourse by several of the rivers. They were more numerous seventy years ago than they are at present. About that period, the small-pox was introduced, which made a sad havock; and the indulgence in rum has had a similar effect. They are, however, now scattered on the whole coast; and though they have mingled with some of the aboriginal tribes, from which they have derived the name Zambos, yet the mark of their African origin is visible among all of them. The principal stations of these tribes are in the vicinity of Cape Gracias A Dios, where they are said to be capable of mustering fifteen hundred warriors. Attempts have been made by their means to carry on a contraband trade in European goods, with the more populous parts of Guatimala; but it has been found easier to effect the same object by bribing the Spanish governors and officers of revenue, than to trust to the sobriety and honesty of these uncivilized tribes.

Vera-Paz.

Vera-Paz, the next province to Honduras, includes the Gulf Amatique, and the Gulf or Bay of Dolce, within its limits. These inlets are capable of receiving large vessels, and might be made useful channels of commercial intercourse with the South Sea; but it is less known to us than any other part

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of Guatimala. Vera-Paz is about 120 miles in length, and 70 in breadth. It is very thinly peopled, and very slightly cultivated. The climate is unhealthy, and it rains nine months in the year, so that the lower lands are almost perpetually inundated. Its capital is the town of Coban, or, as it is sometimes called, Vera-Paz. It is built on the banks of a river of the same name, which runs into the sea by the Gulf of Amatique. What little commerce originates in this province is conducted by the gulfs to the neighbouring port of Truxillo, and from thence to their respective destinations. Its exports are merely a few dyeing woods, some honey and wax, and a little cocoa.

Chiapa.

Chiapa, the next province to Vera-Paz, is wholly inland, as the province of Vera-Cruz, in the viceroyalty of Mexico, is interposed between it and the Carribean Sea to the north, whilst the province of Guatimala Proper separates it from the Pacific Ocean. It is 250 miles in length from east to west; in its broadest part it is 300 miles, and in its narrowest part 90 miles. The productions of this province are very valuable, consisting of all kinds of wood, cedar, cypress, oak, and walnut, for building houses and ships, as well as logwood and other dyes. It produces abundance of corn, maize, cotton, cocoa, and sugar; and the inferior cochineal, the *Grana silvestris*, is plentiful. The breed of its horses is highly valued, and the richer inhabitants of the city of Mexico are generally supplied from this district. There are neither mines of gold or silver in the province; and the inhabitants, wanting the seductive pursuit of those attractive metals, have generally directed their attention to the more beneficial labours of agriculture. Although the province of Chiapa does not touch the sea coast, it has an advantage more than equivalent in the great river Tobasco, or Grijalva, which almost encircles it, and affords an excellent outlet for its surplus productions. It also enjoys the navigation of the great river Sumasinta on its eastern frontier, which, after a long course, empties itself into the Gulf of Terminos, between Campeche and Vera-Cruz.

There are two cities in this province, Chiapa de los Indios, and Chiapa de los Espanioles. The latter, sometimes called Chiapa Real, is the seat of the government, of the courts of justice, and of the bishop of the province. The cathedral is a magnificent building, and there are several rich monasteries. The city was anciently incorporated, and its municipal Cabildo enjoys extensive privileges and considerable wealth. It is not a place of extensive trade, and the inhabitants are more distinguished by their pride and their titles than by their wealth or their knowledge. The other city is about forty miles distant, and much more populous and flourishing. As its name Chiapa de los Indios denotes, its population was originally Indian; but the fertility of the soil, and the advantages of the vicinity to the river Tobasco, have drawn to it numbers of the enterprising and industrious; and its population is said to amount to more than 20,000 souls, whilst its ancient rival can scarcely number 4000.

The air of this province is generally very dry; being, in a great measure, sheltered by the mountains of Yucatan; it has less of the cool air which the tropical winds convey to refresh the temperature of this burning region, and it is in consequence very hot. The remark of Humboldt, "that the healthiness of situations in the equinoctial regions depends less on the ratio of heat than on that of humidity," is illustrated by the state of this district; for, though excessively hot, Chiapa is remarkably healthy, and has furnished as striking instances of longevity as any part of the globe. This province has obtained considerable celebrity from its first bishop, Bartholomew de las Casas, who exaggerated the cruelties of the original European adventurers. In the fanatical office of defender of the Indians, he discovered as much folly as humanity, and first invented the African slave trade; and thus, to cure evils in a great measure imaginary, and certainly heightened in the representation, introduced a system which has become the scourge and the opprobrium of humanity.

Guatimala Proper.

The last, but by far the most important, part of all the provinces of this captain-generalship, is Guatimala Proper. It is a narrow border of rich land on the coast of the Pacific Ocean, extending from the province of Nicaragua to Oaxaca, the frontier province of Mexico; being in length about 450 miles. Its capital is St Jago de Guatimala, in 24° 28′ north latitude, and 92° 40′ west longitude, which is also the capital of the whole government. It is on the river Vaccas near the South Sea. The harbour is capable only of admitting vessels of an easy draught of water, and that only at high tides. The city is on a beautiful situation, very well built, and remarkable for the salubrity of its air. It contains about 24,000 inhabitants, among whom are many ancient Creole families, and many rich capitalists. The greater portion of the wealth of the whole kingdom may be said to centre here. It is the residence of the captain-general, who has extensive power and great emoluments. The supreme court of justice, the royal audience, exercises its functions here. It is the seat of an archbishop, has a celebrated university, and those various boards of revenue, police, and commerce, which generally are found in Spanish transatlantic capitals. It was anciently incorporated, and its municipal corporation has extensive power, and enjoys considerable estates. It is in a situation peculiarly exposed to earthquakes, by which it has been considerably distressed. In 1751 it was thrown down, and whilst in ruins a volcano in its vicinity burst over it, and increased the sufferings of the few survivors. It was, however, rebuilt on the same spot, and in the year 1775 experienced a more dreadful concussion; the greater part of the inhabitants were buried in the ruins of their dwellings, and the whole scene of horror equalled, if it did not exceed, any that the history of such convulsions has narrated. After this last calamity the capital was removed to its present situation, about twenty-five miles more southerly, and is become more extensive and beautiful than the former city. Its inhabitants are said to be distinguished by sprightliness, intelligence, and suavity of manners, and the females to possess uncommon beauty. The difficulty of access to markets for the disposal of their valuable produce

Guatimala. checked the growth of riches in this district for a long period. In the year 1798 a project was entertained, which has given them a vent, and has augmented the cultivation and the wealth of the province in an extraordinary degree. The captain-general, aided by the Cabildo, began a road through the forest of Tarifa, and thus opened a passage by land from the bay of Tecuantepec in the Pacific Ocean to the river del Passo, which runs into the Huasacualco, and thus empties itself into the Gulf of Mexico. By this vent, which was opened in 1800, the productions of Guatimala have been conveyed to Vera-Cruz on their way to Europe. The effects of it have been to double the produce of the cocoa plantations, and to multiply those of the indigo farms in a fivefold degree. The great kingdom of Mexico has a demand for cocoa far beyond its growth, and by this new vent it has been amply supplied. Indigo is a production better furnished from Guatimala than from any other part of the western world, and now having a secure passage to the best markets, it will probably go on still rapidly increasing. The present mode of conveyance is by mules from St Miguel on the river Chimalapa to the junction of the rivers Saravia and del Passo, and it has been contemplated to cut a canal this distance of six or seven leagues, and thus obtain water carriage the whole way from Guatimala to the Gulf of Mexico. In noticing such projects, it is impossible not to remark, that these new modes of intercourse, though, in the first instance, beneficial only to the Spanish dominions, would become so speedily to the whole civilized world.

Indigo and cocoa have been already noticed as important productions of Guatimala. The amount of the indigo prepared was estimated in 1805 at L. 600,000 Sterling, and the cocoa exported, after furnishing abundance to the 30,000 fanegas, or nearly 16,000 tons. A considerable quantity of cochineal is collected; but it is generally inferior to that of Oaxaca, the adjoining province. Sugar is raised sufficient for the domestic consumption, but it will not pay the carriage necessary to convey it to market. Cotton is cultivated to a considerable extent, though but little exported; and the gins used in separating the seed from the wool have not yet been generally used, nor have they any presses, by which to reduce the bulk of that article, and render the expence of its transportation more moderate. Hemp and flax are cultivated sufficiently to supply the demand of the country; but though the soil and climate are admirably calculated for those articles, the difficulty of conveyance is an obstacle to their increase.

The most important place after the capital is Sansonate, containing a population, including the surrounding district, of near 40,000 souls; the town itself, however, does not comprehend more than one-tenth of the inhabitants, the rest are on the plantations near it, and consist principally of Indians and mixed casts. St Salvador, a town of about 5000 inhabitants, is twelve miles from the Pacific Ocean, by means of which it carries on some coasting trade, principally in sugar. There are some other places denominated towns, but they are rather the chief residence of the missionaries employed in converting and regulating the Indians, than well peopled places. Ecclesiastical authority is the principal engine used to keep the untutored Indians in subjection; they are generally submissive to the priests, and readily supply them with those comforts which the country yields, often to the neglect of their own relatives. Many of the priests are natives of the country, but some are Europeans; all, however, are obliged to learn the two most prevailing Indian languages, the Poconche, and the Cacchiquel; for though most of the indigenous inhabitants have been taught some portion of the Castilian tongue, they use it with reluctance, and very rarely in their own separate districts. There is great jealousy between those priests who are natives of the country, and those who arrive from Europe; and though the archbishop and the several bishops, in adjusting such differences as arise, should decide with the greatest equity, yet their judgments are received with suspicion, if not with resistance, by the priests of the Indian race.

Revenue, Exports, and Imports.

Notwithstanding the extent of Guatimala and its numerous population, the advantages which Spain derives from its possession are very trifling. The whole of the revenue drawn from the inhabitants, with the tax on the Indians, amounts to scarcely sufficient to pay the salaries of the officers of government. It has little or no direct trade with Europe, and the whole amount of its imports does not exceed L. 450,000 Sterling. Its exports amount to about L. 50,000 more, and being principally to Mexico, the region of silver, the balance is paid in that article.

Recent History.

During the commotions which have agitated many other parts of the Spanish dominions, Guatimala has been very little disturbed; though decided symptoms of insurrection were manifested at the end of the year 1810 and beginning of 1811. The intelligence that the French armies were in possession of Seville and all Andalusia, spread consternation throughout Mexico and Guatimala; in the former, an insurrection, of a most formidable nature, had broken out, by which the north-west part of the viceroyalty, and almost the whole coast of the South Sea, was in a state of resistance to the viceroy.

Morelos commanded this force, and had defeated the royalists in a pitched battle, by which the whole of Oaxaca was open to him, from whence he would naturally have held an intercourse with Guatimala.

At that period, symptoms of turbulence were exhibited in St Salvador by the mulattos of that province. The different mixed casts amounted to 90,000 men capable of bearing arms; the Indians to 65,000. The white population was much more esteemed by the Indians than the mixed Creoles, and though the latter addressed them with promises of abolishing the capitation-tax, and assurances that what they had paid since the imprisonment of Ferdinand should be refunded to them, their adherence to the whites remained unshaken. At first the mulattos committed some excesses at the instigation of leaders who preached equality and liberty in the style of the French Convention. The whites, however, rallied,

Guatimala || Guiana.

and Don Josef Ayzinena, an officer of considerable coolness and judgment, having opportunely arrived, they were enabled, without bloodshed, to restore tranquillity. In the province of Nicaragua, symptoms of similar dispositions were discovered at the same period, but the mulattos were a less proportion of the whole population, and, after various meetings, the different parties agreed to refer all matters in dispute to the bishop, and requested him to exercise the sole authority. As tranquillity was thus restored in the two provinces which were most dreaded, the Captain-General, and the royal audience, supported by the Cabildo of St Jago, were enabled to raise a force of white men, to overawe the mulattos, and give confidence to the Indians.

Whilst these agitations were proceeding, the forces of Morelos, happily for the tranquillity of Guatimala, instead of advancing to Oaxaca, directed their operations towards a different quarter, and thus gave time to consolidate the powers of the different governors of its provinces, and secure tranquillity. Two years afterwards, the insurgents gained possession of Oaxaca; but Morelos ascertained that he could make no impression on Guatimala, and that, if he met with any reverse, it could not be easily repaired at that distance from his resources; he therefore left it to enjoy its tranquillity without molestation.

As the knowledge of the geography of Spanish America was very imperfect when the *Encyclopædia* was published, we have deemed it proper to give the latitudes and longitudes of the most considerable places in Guatimala, according to the most recent authorities.

	North latitude.	West longitude from Greenwich.
Amatique, .	15.23.0,	89. 0.0
Chiapa Real, .	17. 0.0,	93.23.0
Chiapa de los Indios,	17. 5.0,	93.53.0
Valladolid, .	14.30.0,	88.19.0
Cuzcatlan, .	13.40.0,	89.20.0
Gracias A Dios, .	14.30.0,	90. 5.0
Granada, .	11.15.0,	86.15.0
St Jago de Guatimala,	14.28.0,	92.40.0
Nicoya, .	10.42.0,	85.53.0
Omoa, .	15.50.0,	89.53.0
Realexo, .	12.45.0,	87.30.0
San Salvador,	13.40.0,	89.20.0
Soconusco, .	15.28.0,	94.36.0
Suchitepec, .	14.44.0,	93.36.0
Truxillo, .	15.51.0,	86. 8.0
Vera Paz, .	15.50.0,	91.14.0

(W. W.)

GUIANA, or GUYANA, a large district of South America, in which the British, the Dutch, the French, the Portuguese, and the Spaniards, have considerable settlements. It is situated between those vast rivers, the Orinoco and the Amazons, and by means of the Negro and the Cassiquiari, which unite their streams, forms an extensive island, separated during the rainy season by broad belts of water from the rest of the continent. The settlements on the coast extend but a short distance inland. Those belonging to Great Britain, viz. BERBICE and DEMERARA, have been already described in this *Supplement*. The province of SURINAM is described in the *Encyclopædia*, and to that account we have now only to add, that, by the peace recently concluded, it has returned to the dominion of its ancient masters, the Dutch, and is in a state of much higher cultivation than when it surrendered to the British arms. The number of its inhabitants have greatly increased, the cultivated lands have extended farther towards the interior, the clearing the forests has rendered the colony more healthy, and the means of defence against an enemy have been considerably strengthened.

Guiana.

French Settlement of Cayenne.

The French settlement of Cayenne extends along the coast from the river Maroni, which separates it from Surinam, to the river Oyapock, which now divides it from Portuguese Guiana. By the treaty of Amiens the French boundary had been extended to the river Arowari; but when the government of Portugal was established in Brazil, a small force detached from thence seized the province, and though, by the late treaties, it is restored to France, the boundary has been considerably contracted towards the south. The frontier of Cayenne towards the sea extends about 130 miles. The few settlements in the province are at the mouths of the rivers which water it, and produce its fertility. These rivers, like those of the English and Dutch settlements, have but short courses, their sources being in that range of mountains which runs parallel to the coast, about 150 miles from it, which is denominated the country of the Carib Indians, and which has not been penetrated by any European. The two rivers which now bound Cayenne have their sources in the cordilleras farther removed from the coast than the country of the Caribs; they have, therefore, much longer courses, and discharge into the ocean much more copious waters than are contributed by those rivers which run through the French settlements. The most northern river of Cayenne is the Makouri, six leagues south of it is the Malmanouri, and farther south, at nearly the same distance, is the Synamari, at the mouth of which was established the hospital for the colony, being deemed the least unhealthy part of the province. The other rivers are the Mana, the Oyac, and the Approuague.

The island of Cayenne, on which the capital is built, extends about eleven miles from east to west, and sixteen from north to south; it is separated from the main by a small river, which is fordable at low-water, but at high-tide is navigable by boats. The city is built on the north-west extremity of the island, at the mouth of a river of the same name. It is fortified strongly, and a hill within the inclosure commands the whole town and the anchorage of the shipping; it is in north latitude 4° 56′, and west longitude 52° 15′ from London. Both divisions of the town are ill built and badly paved; the streets in the new part are wider, and the houses larger than in the old one, but neither are equal to the generality of even tropical towns in beauty and cleanliness. With the exception of the officers of government, very few of the inhabitants are of the unmixed white race, but are either mulattos, quaderoons, sambos, or negro slaves. Debauchery, indolence, and knav-

Guiana. ery, are the characteristics of the greater part of the people of this city.

History of Cayenne. This colony was first settled in the year 1550 by the celebrated Admiral de Coligny, who, during the civil wars of France, wished to make it an asylum, where the Protestants, if unsuccessful, might retire to follow, in security, their worship and opinions. The course of events in Europe, after the return of Coligny, was such as to prevent the colony from being long an object of attention, and the few settlers were neglected by the government of France for nearly two centuries. Neither the settlers nor the negro slaves increased much, and the few descendants of the original Europeans were so incorporated, by successive intermixtures, with the coloured inhabitants, that the difference of their race was with difficulty to be discovered by their complexions. The colony of Canada engrossed so large a portion of the regard of the French court, that the establishment at Cayenne was only kept from sinking by the accession of a few isolated settlers, who occasionally fixed themselves in it, as a desperate and last resource. When, by the loss of Canada, the other colonial settlements became of more value, an effort was made, upon a grand scale, to increase the population, and promote the cultivation of Guiana.

Under the administration of Choiseul a fleet was equipped, which conveyed to Cayenne 15,000 persons. Few of them possessed property, few of them were handicraftsmen or labourers, and of those, few were disposed to work, supposing the climate would have allowed Europeans to labour.

The settlers were soon visited with the dreadful fevers of the tropics; and those who had the means of returning to Europe abandoned the country with the utmost precipitation. In the year 1763, the numbers that landed were 13,060, of these 2000 quitted it, either for France, Canada, or the West India islands; about 100 enlisted in the colonial battalion, and, at the end of the year 1765, there were only in the colony 430 persons left of the expedition; so that more than 10,000 must have perished in the first two years. The expence of this equipment is estimated to have amounted to thirty-three millions of livres, the whole of which, as well as the vast number of human beings, was sacrificed to a plan in which the splendid rather than the useful was considered, though it was sketched by the celebrated Turgot, and some other of the eminent economists of France. From the period of this disastrous attempt the colony continued to languish till the American war broke out, when the predatory cruisers, both French and Americans, carried in several valuable prizes; many negro slaves were by these captures conveyed to the settlement, and this enabled the planters to extend their cultivation, so that, at the peace of 1783, the colony was in a more thriving condition than it had been at any former period, and it continued to increase in prosperity. The Revolution of France extended its calamities to this colony in a very early stage of its progress. As the rumour of the intended emancipation of all the negroes reached Cayenne, before the absurd decree was passed in the Convention, the richer proprietors, frightened by the menaces of the slaves, fled from the colony; and the popular assembly, consisting principally of men of colour, proclaimed them emigrants, and decreed the forfeiture of their estates. When the decree was received and promulgated at Cayenne, the blacks supposed that their labour was at an end, and that, on the principles of equality, the whites, in their turn, should now be compelled to work for the majority. The whites from the various plantations fled for security to the capital, where the troops were so factious that they could scarcely obtain protection. The miserable slaves in the plantations soon found this boon of freedom to be the severest punishment that could be inflicted. Cultivation became neglected, provisions, in consequence, were scarce, and a short period produced a want of even the commonest aliments. Regulations for fixing the prices of labour were in vain established, for those who could pay their labourers had fled from the country. Though modifications of this absurd decree were afterwards made, they could not produce the former abundance of provisions, and, during the whole period of the war, scarcity continued to be experienced. During the agitations in France, several of the leaders of the unsuccessful factions were banished to this colony, by the decrees of their triumphant opponents. They were not an order of men who were likely to benefit the settlement, and many of them died from the effects of the climate, many from chagrin, and the few survivors who returned to Europe had experienced the most severe and mortifying hardships. As the military force had been neglected, the small body stationed at Cayenne very readily submitted to the Portuguese armament. When it was restored to the King of France, the number of white inhabitants did not exceed 1300, whilst the black and mixed races, including those of Indian origin, amounted together to between 10,000 and 11,000. Many negroes have been since introduced, both from Africa and the other French settlements, and though no accurate returns have been made, the whole population has been recently calculated at 14,000. As the government of France has abolished the slave trade by a formal law, if that abominable traffic should be continued, it must be so cramped, that there is no probability of Cayenne receiving any great addition to its population from the continent of Africa; and as the number of male slaves is greater than that of females, natural increase cannot take place till the sexes approach to an equality in numbers.

Climate. The climate and seasons in Cayenne are so nearly similar to those in Demerara, as to make any notice of them unnecessary; but as the country is much less cleared of underwood, and as very little draining has been practised, it is far more unhealthy than any of the British or Dutch settlements on the same coast. That the climate is totally unfit for European labourers was demonstrated in 1794. When the decree for giving freedom to the negroes was promulgated, the soldiers of the regiment of Alsace, then stationed in the province, were induced, by high wages, to work in the plantations; at the end of a month, one half the regiment had died, and the remainder were so ill as to be incapable of any duty.

Productions of Cayenne.

From the scanty population of Cayenne, it is evident that its productions must be of inconsiderable magnitude; but the experiments that have been made sufficiently show that its capabilities are equal to those of the best soils in the tropical climate. The sugar-cane was, from the first, cultivated with success, but the production of that plant was vastly improved by the introduction of the canes of Otaheite, which the celebrated Bougainville brought from the southern hemisphere; and its sugar is equal to that of Surinam or Demerara. A spirit called by the French Taffia, an inferior kind of rum, is distilled from the canes. The coffee of Cayenne is inferior to that of Surinam, none of the plantations of it are extensive, and it is remarked that the trees degenerate when planted in the lower grounds. The cocoa plant is a native of Cayenne, and grows spontaneously on the borders of the Oyapoe. Wild indigo grows in great quantities, and the dye that has been obtained from it is equal in quality to what is extracted from the cultivated plant of the same species. This induced the French government to promote the production of that commodity in the soil which nature indicated to be well adapted for it. The first results were in almost every instance flattering, but the plant soon degenerated, and most of the indigo plantations, like those of St Domingo, were converted into sugar estates, but not till the proprietors had suffered very heavy losses. Cotton grows very luxuriantly, though not a native plant, or, if it be, the species varies from that now cultivated, which was brought from Guadaloupe, when the ruinous project of colonization was attempted in 1763. This plant yields two crops in the year; the second called by the planters *la petite recolte*, in the month of March is frequently destroyed by a species of caterpillars which cover the trees after a shower of rain. All the fruits peculiar to warm climates are most abundant in Cayenne, and attempts have been repeatedly made to introduce the clove, and the cinnamon trees, with the other plants of the East Indies. The seeds of the clove were distributed profusely by the government, which also encouraged the cultivation of the bread-fruit, the mango, and the sago.

Chief Articles of Commerce.

The exportable article of greatest amount, which Cayenne has lately furnished to Europe, is the Rocou, or Roucou, better known in England by the name of Annotta, and which is extensively used as a dye, principally, however, for silks. The tree which yields this substance (*Bixa Orellana*) grows from twelve to fifteen feet in height, is very bushy, and bears a flower of a pale pink, resembling in shape and colour the dog-rose. The fruit contains a pulpy substance (intermixed with the seeds), of a very glutinous nature, which, by frequent washings and filterings, is separated from them. It is then suffered to ferment during eight or nine days, when it is placed in a vessel, capable of bearing heat, over a fire, and as soon as it forms bubbles on the surface, the fire is withdrawn, and it is suffered to cool. The more gradually it cools, the better the substance is. That which is dried in the shade is much more valuable than that dried by the heat of the sun. When it is macerated in small quantities, it is black and of little value; and is only of the best quality, when the whole that is made at one time is a very great mass. Its purity is ascertained by the whole dissolving in water, without leaving behind it any extraneous substances. When in the state of a soft paste, it is moulded into the form of small cakes, and inclosed in the leaves of the *Canna Indica angustifolia*, and thus packed for its market. The whole process of preparing this drug is most prejudicial to the health and comfort of the labourers. The smell is offensive beyond the powers of description; and during the preparation, the workmen are afflicted with a constant nausea, and most violent headache. Its offensive smell, however, gradually subsides, and by the time it reaches Europe, is changed into an agreeable flavour, resembling that of the violet. On the Continent of Europe this commodity is extensively used in the dyeing of various kinds of clothing; but in England it is almost exclusively applied as the colouring matter of cheese, to which purpose it is well adapted, being nearly tasteless, and perfectly harmless. The pepper to which this settlement has given a name, though produced every where in the tropics, was first sent to Europe from hence. It is the pod of a species of Capsicum, gathered when ripe, and dried in the sun; it is then, with a little flour and some salt, made into a kind of paste, and baked to a biscuit. When perfectly dry and cold, the pepper is made by rasping them upon a grater. Some cassia and a small quantity of vanilla have been produced here for exportation. As no wheat is grown, the dependance of the inhabitants for flour rests on the United States of North America; but maize, cassava, and rice, are cultivated to a sufficient extent, to supply food to the lower orders of the coloured inhabitants. The French seem to have exceeded other nations in the success of their efforts to conciliate the aborigines, and a much larger proportion of the native Indians have been reclaimed, and induced to labour on their plantations, than in either the Dutch or English settlements on the coast of Guiana. Though the soil of Guiana may be as prolific as that of Demerara or Surinam, yet its future products can scarcely be so great as those colonies. The coast is low, and dangerous to approach, on account of the great number of shoals and sandbanks which border it; and the only good navigable river on the whole line is that on which the capital is built. In the prevalence of fogs, in the general humidity of the atmosphere, and uniform high temperature of the air, Cayenne is assimilated to the rest of Guiana.*

Portuguese Dominions.

The boundaries of the territories of Portugal in Guiana were much extended to the north by the first peace of Paris, and those boundaries, having

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* See *Voyage à Cayenne*, par Louis-Ange Pitou; *Histoire des Plantes de la Guyane Françoise;* and *Statistique Generale et Particulière de la France et de ses Colonies.*

Guiana.

been confirmed by the second treaty, may now be considered as finally settled. The northern limit is the mouth of the river Oyapoc, the navigation of which is free, both to the French and Portuguese. A line from the second degree of north latitude till it meets the river Arowari is then the boundary. A line from the first degree of north latitude then separates Portuguese from Spanish Guiana, and proceeds due west till it reaches the mission of St Carlos, on the northern branch of the river Negro. The Negro continues the boundary till it takes an eastern direction, when a line is drawn due south till it strikes the river Maranon or Amazons, both sides of which to its mouth are thus included within the dominions of Portugal. Portuguese Guiana extends about 980 miles from east to west; its mean breadth is about 250 miles, but is not clearly ascertained from the want of accurate surveys of the upper parts of the rivers Negro and Maranon.

The whole of this extensive country is very thinly peopled. The Portuguese have built three towns on the banks of the Maranon, Macapa, Paru, and Pauxis, but there are very few of the European race settled around them, nor have the cities, as they have been denominated, risen to splendour or opulence. The soil and climate are well calculated for the growth of cotton, and the few plantations that have been established have been principally destined to that purpose. Some sugar has been cultivated, but not to an extent that has yet admitted of any moderate exportation. In its present state, with few white inhabitants, negros recently brought from Africa, and native Indians, whom it is attempted to reduce to the condition of labourers, the principal exertions are directed to the production of provisions, which consist principally of manioc, rice, and maize. The inhabitants of all descriptions, including the half reclaimed Indians, who have been collected around the religious missions, are not estimated at more than 36,000, but the number is doubtful as all accounts are very contradictory. The soil, climate, and natural productions, differ so little from those of Berbice, Demerara, and Cayenne, as not to demand a special notice.

The most remarkable object in the country is the Maranon, the largest river in the world, which discharges itself, within its limits, into the ocean. It rises in the lake of Lauricocha in Peru in the 11^{0} of south latitude, and crossing the whole of South America, empties itself into the South Atlantic, by both sides of the Island of St John. During its course it receives the waters of sixty rivers, many of which supply as much water as the Danube or the Wolga discharge into the sea. The largest of these on the right bank are the Ucayle, Yvari, Yutai, Yurba, Purus, Madeira, Tapajos, and Zingu, and on the left bank the Napo, Ica, Yupura, and Negro. It becomes navigable for barges at the junction of the Madeira, where it is nearly five miles in breadth; but the passage from thence is so intercepted with islands, and has such rapids as render its navigation dangerous till the mouth of the Tapajos, which can be reached by ships. The deficiency of productions on its banks has, however, prevented it from being navigated by any vessels from the ocean above Paru. Macapa is in 8′ north latitude, and 51^{0} 8′ west longitude. Paru in 1^{0} 25′ south latitude, and 52^{0} 15′ west longitude.*

Spanish Guiana.

This extensive, but thinly peopled province, comprehending a circuit of more than 3000 miles, was but little known to the European world, till the late journey through it by Baron Humboldt, and had scarcely excited any interest since the expeditions undertaken to discover its mines by Sir Walter Raleigh. It has, of late, drawn general attention from being the country where, after his expulsion from New Granada and Caraccas, Bolivar, the chief of the insurgents, concentrated his forces, and rested to collect, from the disbanded warriors of Europe, an army sufficiently powerful to attempt the conquest of the countries from which he had retreated.

It is separated on the north by the extensive plains of St Juan and Quixos from the Spanish province of Caraccas, and bounded on the west by the Orinoco and the viceroyalty of New Granada. On the south it touches the British dominions in Guiana, and on the east the sea is its boundary. Before late events had made it the theatre of military operations, it only contained 34,000 inhabitants. Of these, 8000 were Spaniards, or rather descended originally from them, but mixed with the Indian and Negro tribes, so as to have acquired almost wholly their complexions. The remaining 26,000 are the various Indian nations, some collected into communities under the Catholic missionaries, and others still in the nomadic state. The country is watered by the vast river Orinoco, and its various tributary streams, especially the copious rivers Apure, Arauca, Campanaro, Sinaruco, and Meta. The plains on the borders of these streams are overflowed during the rainy season, so as to be scarcely habitable by human beings; but as soon as the waters have subsided, a most abundant herbage springs up, and millions of wild cows, of the race originally introduced from Europe, cover the flat country, and find abundant pasture. By moving to higher ground during the inundations, they find subsistence, and have thus multiplied to their present extent. This abundance of animal food seems to have perpetuated the original indolence of the Indian tribes, who seldom cultivate much land for sustenance. Around the missions the monks have induced the converted Indians to labour in the cultivation of gardens, in which are produced all the vegetable luxuries of the tropical climates; and some of the tribes buried in the depth of the forests, where the foot of a European has scarcely ever penetrated, and to whom such abundance of cattle have not extended, cultivate casava and plan-

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* See Condamine, *Voyage à l'Equateur*; and Humboldt's *Personal Narrative*, Vol. IV.

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tains for their subsistence at those seasons when the chace affords them insufficient food.

Upper and Lower Guiana.

The Spaniards have made a nominal division of this country into two provinces, denominated Upper and Lower Guiana. The upper province contains neither cities nor towns, but a number of forts, or missionary establishments, to which the natives have been attracted or driven, and where they were formed into communities under the government of the monks. This province terminates to the southward, at the mission of St Carlos, on the river Negro, in 1° 58′ of north latitude. The Lake of Parima, the supposed scite of the fabulous *El Dorado*, lies to the eastward of this station, surrounded by ranges of mountains, which are inhabited by a tribe of Indians called Guayecas, who, though of a low stature, have always evinced so much ferocity as to prevent any attempts to survey the lake from being successful. These Indians have hitherto resisted all the seductions and the threats of the monks, and still defend the entrance to their territory, so that Baron Humboldt, who wished to have penetrated to the lake, was compelled by them to abandon the attempt. The number of this nation is unknown.

Almost all the natives of this part of Guiana live in a state of nudity; and those around the missions are generally, like their wilder brethren, without clothes. The vanity indulged in adorning their bodies, by painting them, is, however, fully equal to that practised in more civilized society. This rage for finery is carried so far, that Humboldt says it requires the labour of a fortnight for an Indian to get as much of the red paint, called by them chica, as is sufficient to paint himself over; and the first shower of rain to which he is exposed renders it necessary to repeat the costly operation.

The natives of the upper province are a stronger and more laborious race than those on the lower parts of the Orinoco. Those who are in the missions, if they had liberty to do so, would desert them to live among the Spaniards in the lower province, where, by their industry, they enjoy more comforts than in their own districts. Humboldt found them both faithful and tractable, though he did not think it necessary to treat them with that severity which the Spaniards recommended and practised. Whilst the missions of this country were under the guidance of the Jesuits, force was used, and arms employed, to seize the Indians, and compel them to embrace the Catholic religion; and though the court of Madrid most rigidly forbade the practice, it was continued after their dissolution, by the Dominicans and Franciscans, who succeeded them; nor has the system been wholly abandoned till within the last thirty years. Of the effects of the labours of these missionaries, we may form some idea from the account of Humboldt, who saw some of the Indians, whilst mass was performing. "Without having any notion of the practices of the Christian religion, they behaved with the utmost decency at church. They love to exhibit themselves, and will submit temporarily to any restraint or subjection, provided they are sure of drawing attention. At the moment of the consecration, they made signs to one another, to indicate, beforehand, that the priest was going to carry the chalice to his lips. With the exception of this gesture, they remained motionless, and in a state of complete apathy."

Natural History of this Region.

The natural history of this country presents many curious specimens of the animal kingdom. The beautiful birds called *gallitos* (rock manakins) are abundant, the males of which are of a beautiful saffron colour, the females of an olive brown, with yellow on the under wing coverts, and on the tips of the wings. The monkeys are of numerous tribes, most of which our European zoologists are acquainted with, though some had been either ill-described or unknown, till Humboldt's expedition; of these the *Titi* of the Orinoco *(Simia sciurea)* is the most curious. Its face is white; and a small bluish spot covers the mouth and the tip of the nose. No other of the monkey tribe has so much the physiognomy of a child. It has the same expression of innocence, the same playful smile, and the same rapidity in the transition from joy to sorrow. Its large eyes are instantly filled with tears, when it is seized with fear. The sagacity of this little animal is great. It is very fond of spiders and other insects, and upon seeing drawings of them, though not coloured, it stretched out its hand in hopes of catching them, but remained in the greatest indifference when shown skeletons or heads of mammiferous animals. It suffers so severely from cold, that it is difficult, if not impossible, to convey it to our climate alive.

Another species, called the *viudita* (widow in mourning), has hair soft, glossy, and black. Its face is covered with a mask of a square form, of a whitish colour, tinged with blue, which contains the eyes, nose, and mouth. The neck of the widow presents, in front, a white band, an inch broad, and forming a semicircle. The feet, or rather the hind hands, are black, like the rest of the body, but the fore hands are white without, and of a glossy black within. It has a wild yet timid air, and often refuses aliment when in company, though tormented by a ravenous hunger, but when alone, and left to itself, becomes furious at the aspect of a bird, runs and climbs with astonishing rapidity, darts upon its prey like a cat, and kills whatever it can seize. The sight of the smallest Titi puts him instantly to flight.

The most curious and novel species of electrical fish, the *gymnoti*, are found in stagnant pools in the plains, and possess a degree of electrical or galvanic force far greater than has been recorded of any other kind of torpedo. The mode of catching these eels, and the experiments made on them by Humboldt, are among the most singular narrations of that most observing and intelligent traveller. After unsuccessful attempts to take some of these fish, for the purpose of experiments, with nets and with lines, recourse was had to the following plan. About thirty horses were turned into a pond, the noise occasioned by whose hoofs made the animals issue from the mud, and, by their electric strokes, defend themselves from them. The horses became terrified by the shocks that were communicated, but were prevented from escaping from the pond by the loud shouts and long staffs of numerous Indians who surrounded it. The eels, though alarmed by the noises, defended themselves by the re-

peated discharge of the electrical battery, and for a long time seemed to be victorious. Several horses sunk under the violence of the invisible strokes, which they received on all sides, in organs the most essential to life; and, stunned by their force and frequency, disappeared under the water. Others, panting, with manes erect, and haggard eyes, attempted to escape. Most of them were driven back; but the few that were able to regain the shore stumbled at every step, and stretched themselves on the sand; evidently exhausted by the electric shocks. The stroke of the eel was given by pressing itself against the belly of the horse, and making a discharge along the whole extent of its electric organ, attacking at once the heart, the intestines, and the *plexus coelicus* of the abdominal nerves. In a few minutes, two horses were drowned, probably from the impossibility of rising when they had fallen, amidst the prolonged struggle betwixt the eels and them. The gymnoti require long rest and abundant nourishment to repair what they have lost of galvanic force. They became ultimately exhausted, and approached the borders of the pool, where some of them were taken by means of a line by the Indians. Their force was so much impaired, that the Indians who drew them out felt but a very slight shock, if the line was dry.

On examination, these fish were found to be from five to five feet four inches in length, and weighed from ten to twelve pounds. Two rows of spots are placed along the back, from the head to the tail, each of which contains an excretory aperture. From these the skin of the animal is constantly covered with a mucous matter, which is a much more powerful conductor of electricity than pure water.

The gymnoti are neither charged conductors, nor batteries, nor electromotive apparatuses, but the electric shock given by the fish depends on its will; for when one person held the head, and another the tail, one only of them received the stroke. It clearly appeared that the discharge is made at one point only, which is that most strongly irritated. The gymnotus seemed to direct its strokes sometimes from the whole surface of the body, and sometimes from one point only. The action of this fish on the organs of man is transmitted and intercepted by the same bodies that transmit and intercept the electrical current of a conductor. Their abundance in the pools of the plains sufficiently accounts for no other kind of fish being found in them. They kill many more than they devour; and the Indians relate, that, when young alligators and gymnoti are taken in the same net, the latter never display the slightest trace of a wound, because they disable the young alligators before they are attacked by them. All the other animals dread their society; and it became necessary to change the direction of a road, because these eels were so numerous in one river, that they every year killed a great number of mules of burden as they forded it. The muscular part of their flesh furnishes a good aliment to the Indians, but the electric organs are slimy, and disagreeable to the taste, and are carefully separated from the rest of the body.

One of the most important operations performed by the natives is the taking the eggs of the turtle, and rendering them into oil, which becomes an article of extensive traffic, and is applied to the several purposes for which olive oil is used in other countries. The number of these animals that annually come to the sandy plains or islands of the Orinoco are estimated at more than a million, and they each lay generally from 80 to 140 eggs. The ground on which the nests are made is divided into portions among the natives, who each explores and takes up what is found on the land which for the season is his own property. The nests of eggs are deposited about three feet below the surface. The sand is removed, and the eggs are collected in small baskets. They are thrown into wooden troughs, and exposed to the sun, being frequently stirred with shovels, till the yolk, the oily part which swims on the surface, has time to separate. As fast as this oil is collected from the top, it is boiled over a very quick fire. It then becomes limpid, tasteless, and nearly colourless, and is used both in lamps and for dressing food. The produce of this *harvest of eggs*, as it is called in the country, is usually about 5000 jars of five gallons, and each jar is calculated to contain the yolks of 5000 eggs. These turtles do not appear to diminish, though, when young, they are the prey of herons, vultures, and crocodiles; and, when full grown, are caught by the jaugaurs or tigers, who with singular dexterity contrive to extract the flesh for their food, though they are unable to separate the upper from the under shell. The wild Indians also destroy many of them by repairing to the banks of the river at the commencement of the rainy season, and shooting them with poisoned arrows in the head, the only part that is visible as they swim on the water.

The wild tiger cats are both numerous and fierce; but, finding abundance of prey in the flocks of the goat tribe, they are seldom rendered so voracious by hunger as to attack human beings. The number of venomous insects, of various species, almost exceeds belief, and are a terrible annoyance to travellers; the more harmless races of reptiles, the iguanas, lizards, and others, almost cover the surface of even the naked rocks. The heat of the climate is such, even on the most hilly parts of the Orinoco, that it is scarcely supportable by man. The beasts of the forests hide themselves in the thickets, and the birds retire beneath the foliage of the trees, or into the crevices of the rocks. The honey of wild bees is very generally found, and their enormous hives are suspended to the branches of the trees.—We feel some degree of impatience for the future volumes of the *Personal Narrative* of Humboldt, which, like those which have already appeared, will throw much light on the natural history of this most interesting country.

Lower Guiana is situated between the rivers Orinoco and Essequibo, and on the western side extends to the river Caroni. The greater part of this, like the upper province, is a waste, and not even much traversed by the Indian tribes, all of whom live in terror of the Caribs, who inhabit a range of mountains on the south-eastern part, and are a strong, active, and warlike nation.

The only settlements of European foundation are those on the banks of the Orinoco, where a few Spaniards have long been established, and exercise a portion of authority over the whole country. The mouths of the Orinoco give them the means of maintaining some slight intercourse with the European world.

The capital of the Spanish settlements, recently called Angostura, but more properly St Thomas, is on the south side of the river Orinoco, and about a mile from its banks. An indentation of the river forms a natural basin, which reaches the city, and is a receptacle for the vessels that navigate the stream. It consists of one line of houses, large, and built of stone, which extends near a mile in length. The palace formerly belonging to the bishop, that of the governor, the goal, and a few private houses, are handsome; the others, though large, are gloomy, filthy, and destitute of furniture. Though before the present troubles there were a few rich merchants, it never was a flourishing place. A new cathedral was erecting when the insurrection began. It is now suspended, and, in the six years that have elapsed, is nearly in ruins. The fortifications around the city are too extensive to be defended without a more numerous army than the country can subsist, and therefore those who were masters of the field and of the river took it with but little difficulty.

Old Guiana, another town on the same side of the river, but lower down, is a miserable place; but has adjoining to it a citadel of great strength, on a hill, to which there is but one narrow pass, which is enfiladed by the guns of the fort. This place is of considerable importance, because it commands the river, and prevents any vessels ascending to Angostura. The trade of this province was, even in tranquil times, but very insignificant. The produce that it was enabled to export consisted of hides, mules, tobacco, cured beef, and some small quantities of cotton and indigo. These were sent to Trinidad, and the European necessaries for the colony were furnished from the stores there, as long as that island continued in the possession of Spain. When it was ceded to Great Britain, the commerce was carried on with the Spanish port of St Domingo and with Cuba.

The navigation of the Orinoco is very bad. In the dry season, the water is too low to admit vessels of any burden; and in the wet season, the various mouths of the river are difficult to be explored, from the whole delta being so completely covered as to afford no land-marks by which to ascertain the proper channels.

The bands of insurgents under Bolivar, who were conveyed to the Orinoco by Brion's fleet, found it a place of security after Old Guiana was occupied, and they were there enabled to recruit their armies by various volunteers from the disbanded troops of the European powers. The river, too, was a favourable course by which to receive military stores, which could not be intercepted by the large vessels of Spain, who were incompetent to watch its numerous and distant entrances. In this secure asylum, the forces of Bolivar were recruited and organized; and, by ascending the rivers, and crossing a branch of the Cordilleras, they were enabled to reach the rear of the defences of the Spaniards, and, according to accounts which appear to merit some degree of credit, to capture the city of Santa Fé.* (W. W.)

GUYTON DE MORVEAU (Baron LOUIS BERNARD), a celebrated Chemist; known also as an advocate of eminence, and less advantageously, in his political character, as a regicide; son of Antony Guyton de Morveau and Margaret de Saulle his wife, was born at Dijon, 4th January 1737.

His father was of a respectable family, and filled the situation of a Professor of Civil Law in the University of Dijon. He was fond of building; and from the artificers who were frequently employed about his house, young Guyton appears to have derived, almost in his infancy, a taste for mechanical pursuits, which led to an astonishing developement of premature talent. For when he was only seven years old, he prevailed on his father to purchase, for his amusement, a clock which was greatly out of repair, and, as is said, he actually put it together and remedied its defects, without any assistance, so effectually that it continued to go extremely well for 50 or 60 years afterwards. The next year he was equally successful in cleaning and repairing a watch belonging to his mother. But, notwithstanding these remarkable exertions of ingenuity, it does not appear that they depended on any particular bent of the genius to the cultivation of the mechanical arts: at least no such bent was ever exhibited in any of his subsequent pursuits. His education was conducted in the ordinary manner at a provincial school or college, which he left at 16. Upon his return home he applied, for a short time, to botany, and he was soon after admitted as a student of law in the University of Dijon, where he remained for three years, and then removed to Paris, in order to continue his studies at the bar. In 1756, he paid a visit to Voltaire at Ferney, and he seems to have imbibed from this personage a taste for satirical poetry, which he soon afterwards displayed, upon the occurrence of a trifling accident, in a ceremony relating to a popular Jesuit of the day. Among his posthumous papers, also, he left some unfinished sketches of tragedies, which are said not to have been deficient in poetical merit.

At the age of 24, when he had made some progress in the practice of his profession as an advocate, his father procured for him, at the price of 40,000 francs, the appointment of Advocate-General of the Parliament of Dijon, so that he had no farther solicitude for the acquisition of an income adequate to his competent subsistence. His health was then considered as delicate; but the fears which were entertained for it proved to be completely groundless.

In January 1764, he was made an honorary member of the Academy of Sciences at Dijon, then lately established under the patronage of the Prince de

* See Humboldt's *Travels; El Viagero Universal,* por Estalla; and *Voyage à la partie Orientale de la Terre Ferme,* par Depons.

Condé. This occurrence seems to have had considerable influence on the pursuits which occupied his leisure hours; and he soon became by far the most distinguished ornament of the Academy which had paid him the compliment. His particular application to chemistry arose in a great measure out of an accidental emulation with Dr Chardenon, who afterwards very liberally undertook to assist him in the cultivation of this branch of science. He studied the works of Macquer and of Beaumé, and he was furnished by the latter with the materials necessary for the establishment of a small laboratory for his own use.

With regard to the more general cultivation of literature and science, he displayed considerable talent in a memoir on public instruction, together with a plan for a college, which he presented to the Parliament of Burgundy, insisting, with great force and success, in opposition to Diderot, on the importance of early education in modelling the character of the human mind. He wrote also, about the same time, for a prize essay, an Encomium on Charles V. of France, surnamed the Wise, which was afterwards inserted in the collection of his *Discourses*, published in three volumes.

In July 1767, he visited Paris with a view to the advancement of his scientific pursuits, and excited the admiration of the most celebrated chemists of the day, by the facility which he had acquired in the manipulation of his experiments. He entered, after his return, into the investigation of the great question respecting the oxydation of metals, though he did not succeed in removing the difficulties which then embarrassed it. In 1769, he pronounced, at the opening of the Parliament, an elegant oration upon morals. He was soon afterwards engaged in some experiments respecting the communication of heat to different substances, the results of which, though not published, were of some importance to the theory of temperature. At the request of his friend Dr Durande, he undertook to inquire into the nature of biliary calculi, which he found to be readily soluble in ether; and it appears that a combination of ether and oil of turpentine was of advantage to several of Dr Durande's patients, who were suffering from these concretions.

In the year 1773 he was employed in an interesting investigation of the mutual adhesion of the surfaces of solids and fluids, a class of phenomena of which the mathematical theory was never at all understood, until the publication of an essay on the Cohesion of Fluids in the *Philosophical Transactions*, soon after the beginning of this century, in which the laws of capillary action are extended to a complete analogy with all the experiments of M. de Morveau, as well as those of Taylor and Achard of a similar nature. He succeeded, about the same time, in discovering a mode of destroying the contagious vapours of pestilential diseases, by fumigation with the muriatic acid gas; he afterwards found the oxymuriatic acid, or pure chlorine, still more effectual; and it does not appear that the nitric acid, afterwards proposed in England, has any advantages over either of these substances.

M. de Morveau's anxious desire to cooperate in the promotion of chemical knowledge induced him to make a new exertion in its favour, by undertaking, in 1776, to deliver a public and gratuitous course of lectures as a regular professor of the science, authorised by the approbation and encouragement of his brother magistrates at Dijon. He soon afterwards wrote some essays on the peculiar characters of the carbonic acid, and he strenuously combated the popular prejudice, which prevailed, against the introduction of conductors, for preserving buildings from lightning. He established a large manufactory of nitre, which was afterwards conducted by Mr Courtois, the father of the Mr Courtois that discovered iodine. From chemistry he naturally diverged into the study of mineralogy, and, in 1777, he made a tour through the province of Burgundy, with a view to the examination of all its productions; and he actually discovered a rich lead mine, though, for want of coal, it was impossible to derive much benefit from it. He also found a white variety of the emerald in the same province, as well as some combinations of barita, and he invented a new method of obtaining the pure barita from its sulphate.

He had long been intimately acquainted with the Count de Buffon and with Malesherbes, both persons distinguished by elegance of taste; the one in science, the other in general literature. In 1779 and 1780 he enlarged his connexions among the men of letters resident at Paris, and he was induced by Panckoucke, the bookseller, to undertake the chemical department of the *Encyclopédie Méthodique:* but it was six years before the *Dictionary of Chemistry* appeared; the articles relating to pharmacy and metallurgy were supplied by Maret and Duhamel. In the progress of this work he found himself compelled to disbelieve the existence of phlogiston as a distinct principle of inflammability, though at the beginning he had defended the doctrines of the old school. But he soon became one of the most zealous advocates of the new theory; and he contributed very much to its general introduction by the active part which he took in the arrangement of a new nomenclature. His proposals were at first thought objectionable by many of the members of the Academy of Sciences; but they soon became generally adopted throughout Europe: and the system was without doubt of great use for a time, so far as it assisted the memory and the imagination in retaining the discoveries and comprehending the theories which had so much of novelty to make them interesting. Among the original matter contained in the *Dictionary* were some researches on the nature of steel, which coincided in their results with those of Monge, Vandermonde, and Berthollet, made about the same time, but published somewhat earlier. The whole volume was received in the most flattering manner by all the lovers of chemistry; but it was not till 1791, that the author's ambition was gratified by the award of the Academy of Sciences, adjudging him a prize of 2000 francs, which had been allotted to the most useful work that should appear in the course of the year. The prize, however, he begged to offer to the exigencies of the state, which were then very urgent. The *Dictionary* was afterwards ably continued by M. de Fourcroy.

In the meantime, he condescended to appear as

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the translator of the *Opuscula* of Bergman, which he illustrated by notes. The example was followed by Madame Picardet, and by others of his friends, who were zealous for the promotion of science; so that the French chemists were speedily made acquainted, by these means, with the labours of all their contemporaries in different parts of the world. In the year 1787, Mr Guyton applied his speculations to a practical purpose, in establishing a manufactory of soda from common salt, exposed to the atmosphere, with a large proportion of lime, the soda slowly efflorescing as a carbonate. It was in the same year that, having published his *Collection of Pleadings*, he finally resigned his office at the bar, in order that the whole of his time might be devoted to the pursuit of science.

His next undertaking was of a more adventurous nature; for, in April 1784, he ascended with the President de Virly in a balloon, and he repeated the experiment in the month of June, hoping to be able to direct his aërial course at pleasure. The balloon appears to have been about thirty feet in diameter; and, when we consider the action of the wind upon a surface of such extent, we must be aware that every attempt to oppose or modify it must have been perfectly futile. He was visited soon after by the ingenious and lamented Mr Tennant, who went to Dijon purposely in order to become acquainted with him, and who had an opportunity to perform some original experiments in his laboratory. He was made a Member of the Royal Academy of Medicine at Paris, in 1786, as a compliment to the merits of his labours for the preservation of the public health. He received a visit, in the succeeding year, at once from MM. Lavoisier, Berthollet, and Fourcroy, together with Monge and Vandermonde; and our countryman, Dr Beddoes, who was travelling in France, had the good fortune to join this interesting party, all of them deeply engaged in the discussion of the great chemical questions which were then undecided. In April 1788, Mr Guyton was placed on the list of the Foreign Members of the Royal Society of London, and the same mark of respect was also paid him, at different times, by almost all the scientific societies of Europe.

In September 1791, he was unfortunately elected a member of the Legislative Body, and having also been made Solicitor General of his department, he could no longer continue the chemical lectures, which he had delivered without intermission for fifteen years, and he resigned his chair to Dr Chausier. It must not be omitted by an impartial biographer, that, on the 16th of January 1793, he thought himself compelled to vote with the barbarous majority; and it is a poor compensation for this fatal error that, in the same year, he resigned a pension of 2000 francs a year, in favour of that republic, to which he had already sacrificed the best feelings of justice and humanity. He afterwards became a Commissary of the Assembly, attached to the army of the Netherlands. In this capacity, besides many other instances of personal courage, he is said to have rendered essential service to his countrymen by the construction of a balloon, in which he ascended, together with some of the staff of General Jourdan, in order to observe the motions of the enemy during the battle of Fleurus. After his return to Paris, he was appointed Professor of Chemistry in the *Ecole Polytechnique*, and he was an effective cooperator in the first establishment of that useful institution. In 1795, he was again chosen a member of the Assembly of Five Hundred; and he was appointed by the government one of the forty-eight Members of the National Institute, then recently embodied. He had for some time been a correspondent, but was never a member, of the Academy of Sciences. His political engagements terminated in 1797, when he resolved to devote himself once more exclusively to science. In 1798, he fulfilled the duties of Director of the *Ecole Polytechnique*, during the absence of Monge, who was in Egypt, and for whom he insisted that the salary should be reserved. The following year, Bonaparte, then First Consul, made him a General Administrator of the Mint. He received the Cross of the Legion of Honour in 1803, and obtained, two years afterwards, still higher rank in the order, particularly as an acknowledgment for the public benefits which had been derived from his methods of fumigation. In 1811, he was elevated to the dignity of a Baron of the French empire.

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From 1798 to 1813, he had continued his labours as Professor of Chemistry in the *Ecole Polytechnique;* he then obtained leave to retire, but he survived only a few years, and died of a paralytic affection, or rather of a total decay of strength, the 21st December 1815; at a period when he would shortly have had to encounter the effects of a retributive justice, which would have been very severely felt at so advanced an age. In stature he was rather below than above the middle size; his conversation was animated and copious, his manners courteous and obliging, and he was full of anecdote, and ready to communicate whatever information he possessed. He married, late in life, Madame Picardet, the widow of an academician of Dijon, whose tastes and pursuits were congenial with his own, and who had distinguished herself by translating several works of science and of literature from the different languages of the north of Europe. Of his numerous publications, a bare catalogue will be amply sufficient to show the extent of his researches and the variety of his pursuits. It is the more necessary to do justice to his diligence and perseverance, as we cannot easily point out any one important discovery or invention that can be considered as commensurate to the high promise of his early infancy. The article Acid of the *Dictionary*, and the *Methodical Nomenclature*, must be ranked as the best of his productions, but the character of both these is rather useful than splendid.

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(*Life*, by Dr Granville, *Journ. R. Inst.* 1817.)

(L. S.)

HAD

Situation. HADDINGTONSHIRE, or, as it is frequently called, EAST LOTHIAN, a county in Scotland, situated between 55^0 $47'$ and 56^0 $5'$ north latitude, and between 2^0 $25'$ and 3^0 $2'$ west longitude, from Greenwich. Its boundaries are the Frith of Forth and German Ocean on the north and east; Berwickshire on the south; and Edinburghshire, or Mid Lothian, on the west. Extent. From west to east its extreme length is about 25 miles, and its greatest breadth from north to south 17 ; but, from the irregularity of its boundaries, the area is computed to be only 272 square miles, or 174,080 English acres ; of which about four-fifths may be in tillage, or fit for cultivation, and the remaining fifth, consisting of hills or moorish ground, in its natural state, covered with heath and the coarser grasses. Of this last description is the greater part of the Lammermuir hills, which cross the county in a direction from south-west to north-east, where they terminate in the bold promontory of St Abb's Head.

Surface. From this range of hills on the south, Haddingtonshire appears, when viewed from some commanding eminence at a distance, to slope gradually to the Frith of Forth and the German Ocean ; but, upon a nearer survey, the acclivity from the sea is found to consist of nearly parallel ridges, running from west to east, most of which commence near the western extremity of the county, and traverse the greater part of its length. At the termination of these ridges on the east, there is a most fertile and extensive plain, which has the Lammermuir hills on the south, and North Berwick Law on the north. Some of the hills in the low country, though of no great elevation, are very conspicuous objects, owing to their rising suddenly from a flat surface, and being exposed to view on all sides, surrounded by low

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hire.

grounds. North Berwick Law on the coast, 940 feet high, Traprane Law, 700, and the Garleton hills, almost in the centre, not only themselves hold a prominent place in the landscape, but afford from their heights a view of some of the richest and most beautiful scenery in Britain. The Lammermuir range on the south, which appear, when viewed from the Garleton hills, to rise in the form of a vast amphitheatre, as if to protect and shelter the lower part of the county, present in their dark and rugged surface a striking contrast with the highly cultivated plains below. Over these plains, from the same station, the eye takes in the ports of Dunbar, North Berwick, Prestonpans, and Cockenzie, with the islets of the Bass, May, and others on the coast, and the shipping on the Frith of Forth; while nearer and all around lies an extensive tract of the most fertile land in the island, covered, if seen in a fine evening early in autumn, with rich crops of every hue, and studded with habitations of great variety, from the princely mansion, indistinctly traced through the variegated foliage of its woods, to the cottage of the peasant, sending up its slender column of smoke in the rays of the setting sun.

Almost every variety of soil known in Britain is to be found here; but it appears from the Agricultural Survey that clay and loam, nearly in equal proportions, though each of various qualities, extend over about two-thirds of the county; yet a great deal of both descriptions is not naturally very fertile, much of the clay, in particular, being shallow, and incumbent on a wet bottom. Tracts of moorish soil are also found interspersed among the lower grounds.

ate.

The climate, though as various as the soil, is, in an agricultural point of view, perhaps the best in Scotland, especially for the growth of corn. In the eastern parts, very little rain falls during the summer months; a circumstance to which is ascribed the superior quality of the grain. Here, also, harvest commences ten days earlier than upon the coast lands on the north, though on these last it is still earlier by three weeks or a month than upon the hills. In the Lammermuir district, snow in some seasons covers the ground entirely for three months, and lies on the north sides of the hills till after midsummer, though they are only 13 or 14 miles from the sea; while upon the coast it commonly melts as it falls. From December to May, the winds are chiefly from the east and north; in summer, when the weather is dry, from the east; and in autumn, from west to south and south-east, the last often accompanied with rain and fogs. The north-west brings storms in winter; and from the same quarter, and also from the south-west, come the high gales which are sometimes so injurious in autumn.

ers.

Haddingtonshire, though it has a number of streams, sufficient, perhaps, for the common purposes of its population, possesses no lakes; no other river than the Tyne, and that is an inconsiderable one; and enjoys no internal navigation, nor fresh water fishery. The Tyne, which springs from the moor of Middleton in Edinburghshire, enters this county on the west, near Ormiston; and flowing nearly due east, passes Haddington, the county town, and falls into the sea beyond Tyninghame, the seat of the Earl of Haddington, after receiving the Peffer from the north, and Coalstone and a few other rills from the south. Yet it has sometimes swelled to a great height, and occasioned much damage. In 1775, the whole suburb of Haddington called *Nungate*, and more than half the town, were laid under water.

Haddingtonshire.

Minerals.

This county is not less fortunate in its mineral productions than in its soil and climate. Coal, which has been wrought here since the beginning of the thirteenth century, is found in great abundance in the western parts of it, from the borders of Lammermuir to the sea; particularly in the parishes of Tranent, Ormiston, Gladsmuir, and Pencaitland. Hardly any part of the district is distant six miles from limestone; several extensive parishes rest on a bed of this rock. Marl is also found in different parts; though, since the use of lime became so general, it is not raised to a great extent. Sandstone or freestone, which prevails very generally throughout the county, is wrought, of an excellent quality, near Barra, and in Pencaitland and Tranent. On the west side of the harbour of Dunbar there is a remarkable promontory, resembling the Giant's Causeway in Ireland, composed of a red stone, apparently a very hard sandstone. It runs out to the north about 100 yards, and is 20 yards wide, having the sea on each side on the flow of the tide. The diameter of its columns is from one to two feet, and their length at low water 30, inclining a little to the south. Ironstone has been found in the parishes of Humbie, Keith, Oldhamstocks, and Tranent, and mineral springs at several places, some of which were once much resorted to, but are in little repute at present.

Estates.

The county of Haddington was divided in 1811 into 183 estates; of which 23 were above L. 2000 Scots of valuation, 52 above L. 500, and 133 below L. 500. The valuation of the whole is L. 168,873, 10s. 8d. Scots; of which L. 1305, 4s. 3d. belonged to corporations, and L. 56,257, 3s. to estates held under entail. And in the same year, the real rent of the lands, as returned under the property-tax act, was L. 180,654, 5s. 9d. Sterling; and of the houses, L. 6780, 15s. 2d. Sterling. Thus the land-rent of the whole county, the Lammermuir hills included, was almost a guinea an acre. In 1800, among the proprietors were 10 noblemen; the number of freeholders who vote in the election of a member for the county was then 71, and has varied from 78 to 70. The nobility who have seats in the county are the Duke of Roxburgh, the Marquis of Tweeddale, the Earls of Haddington, Wemyss, Hopetoun, Lauderdale, and Dalhousie; the Lords Sinclair, Blantyre, and Elibank. Several other proprietors have elegant mansions, which tend greatly to ornament the districts in which they are situate.

Rental.

Farms.

The farms are not generally what in some other parts of Britain would be called large. Their average size may be from 300 to 500 English acres over the whole of the arable land, but smaller on the best soils, and larger, perhaps, on the inferior. On land of a medium quality, 300 acres is not considered a small farm. All the farms are held on leases, com-

Haddingtonshire.

monly for 19 or 21 years, which do not often contain any covenants that are not equitable and liberal; except that here, as throughout the rest of Scotland, the tenant is seldom allowed to sublet his farm or assign his lease, or even bequeath it by testament,—the heir-at-law succeeding to the farm as a matter of course, though not to the stock or crop upon it. This arrangement has often been complained of by both parties, though in few cases has it been set aside by mutual agreement. The landlord, on the one hand, would wish to oblige the tenant to leave to his heir-at-law a stock sufficient for the cultivation of the farm; and the tenant, on the other, desires that he should be left at liberty to dispose of his lease, and the capital he may have invested in the improvement of his farm, without any other condition than that the possessor shall become bound to the landlord for the performance of all the obligations he had himself come under.

Agriculture.

Agriculture is the chief employment of the people of this district, which has long been celebrated for yielding a greater produce and higher rents than perhaps any other tract of corn land of the same extent in any part of Britain; while, at the same time, the farmer and the labourer, each in his own condition, have long maintained a high character for knowledge and industry; the one enjoying the fair profits of his skill and capital, and the other the reward of his useful services, in a degree of independence and comfort which is far from having been so general of late in other parts of the island. The principal object on the low grounds, in many situations almost the exclusive object, is the growing of corn; the dryness of the climate is thought to be less favourable to grazing and cattle crops; and, with the exception of the Lammermuir district, very little is kept in pasture for more than one or two years. The general rule by which the course of cropping is regulated is not to take two crops of corn successively, but to interpose peas or beans, with cultivated herbage, commonly rye-grass and clover, on the clays; and turnips, with the same sort of herbage, on dry loams and sandy soils. On strong clays, a clean fallow once in four, six, or eight years, is considered indispensable. In a six years' course on clays, a third of the land is under wheat, which is almost universally taken after the fallow, and also after the beans; the order being fallow, wheat, herbage, oats, beans, and wheat. On inferior clays a fallow is made every fourth year, and only a fourth of the land is usually under wheat. On the best dry loams wheat, in a few instances, may be taken every second year, in the order of turnips, wheat sown in winter and spring, herbage, and wheat. But this severe course, if it be in any case profitable for a number of years, can only be adopted in situations where more manure can be applied than is made from the produce of the farm itself. As there are no towns of any size in the county, and few or no considerable manufactories, an extra supply of manure could only be procured from the lime-works, if it were not that much of the coast land is plentifully supplied with sea-weed. This article, as well as lime, is therefore used to a great and most beneficial extent, and affords a degree of facility in the cultivating of corn, without deteriorating the soil, which does not exist in many other districts. On well managed soils, though not of the first quality, the produce may be about 30 bushels of wheat, 48 of oats, 40 of barley, 27 of beans, and from $1\frac{1}{2}$ to 2 tons of hay at one cutting the English acre.

Farm-Servants.

The farm-servants are, with very few exceptions, married, live in cottages on the farms, and are paid altogether, or nearly so, in produce, each having a cow kept for him throughout the year. The occasional labourers reside in the villages, which are scattered over the county; a much better situation for men who depend upon several employers, than if they were set down on particular farms. By this arrangement, which is common to several other parts of Scotland, the labouring classes in agriculture possess all the advantages ascribed to cottage farms, without being exposed to those evils which both theory and experience assure us that a general system of cottage farms is calculated to produce.

Live Stock.

The breeding of live stock is almost confined to the Lammermuir district, which is stocked chiefly with sheep of the Linton or black-faced breed. On the low grounds, it is thought to be more profitable to buy the animals at a proper age than to rear them; horses from the west of Scotland, cattle from the north, and sheep from the hills of Tweeddale and Roxburghshire. Generally speaking, cattle are kept only in such numbers as to convert the straw into manure, getting a few turnips along with it, and are commonly sold in spring for the pastures of the south; and, in summer, their clovers, except what part of them is wanted for hay, are fed off, as well as their turnips in winter, with sheep. The dairy is nowhere an object of consideration beyond the supply of their own domestic wants.

Improvements.

Haddingtonshire has taken the lead in several important rural improvements. Lords Belhaven and Haddington, early in the last century, wrote useful treatises on husbandry and forests. In 1750, the first turnpike act for Scotland was obtained for repairing the post-road through it. Wight, one of its farmers, who, like Arthur Young, made tours for collecting agricultural information, contributed much, by his publications, to improve the practices of this and other parts of Scotland; and Meikle, an ingenious mechanic, first brought the thrashing mill into an effective state.

Defects.

Yet, in this pattern county, defects have been pointed out, or admitted to exist by some of its most enlightened farmers. More land, it is alleged, might with advantage be devoted to grazing; the drilling of corn might be found beneficial in many situations; the general use of two horse carts, in preference to single horse carts, is not thought to be sufficiently accounted for by the state of their roads; and a great part of the corn land is open, or very indifferently inclosed. The farm cottages, too, are not only very inferior to those of England, but have not always kept pace with the improvement of the other farm buildings. To these we may add, that a common of about 4000 acres, belonging to the royal burgh of Dunbar, seems to be condemned to perpetual sterility.

Towns, Haddington.

As very little of the labour and capital of Haddingtonshire is employed in manufactures and com-

merce, it will be sufficient to notice these branches under the towns where they are carried on. Haddington, the county town, and a royal burgh, is situated on the Tyne, some miles from the sea, almost in the centre of the lower district, and sixteen miles east from Edinburgh. Excepting an extensive distillery, which has been recently erected, it has scarcely any manufactures which find their way out of the county. Several trials have been made to establish a woollen manufactory, and a few others without success. But its trade, though nearly confined to a single article, is more considerable; for, in its weekly market held on Friday, a greater quantity of grain is sold in bulk than in any town in Scotland. Sometimes nearly a thousand bolls of wheat alone (500 Winchester quarters) are brought there for sale in one day, and the actual sales in bulk, besides what is sold by sample, may be from 400 to 800 bolls weekly. The sales of barley, oats, peas, and beans, are also considerable; and all that is thus sold is for ready money. A great part of it is bought for the consumpt of Edinburgh. This market has been justly considered as one great cause of the prosperous state of the agriculture of this county, as well as the principal support of the town itself; and yet no provision has been made for the accommodation of either sellers or buyers; the carts loaded with grain standing crowded together on the streets, exposed to all sorts of weather, and hardly accessible to the buyers without some degree of danger. In 1811, the town and parish of Haddington contained a population of 4370, of which about half the families were returned as employed in agriculture.

bar. Dunbar, another royal burgh, and a sea-port, is situated on the east coast of the county at the entrance to the Frith of Forth, twenty-seven miles east from Edinburgh. It is a place of great antiquity, and, with its castle, makes a considerable figure in Scottish history, having been the theatre of many important events before Britain was united under one sovereign; but for the history and antiquities of the county we must refer to Chalmers's *Caledonia*, Vol. II. Shipbuilding, with the making of sail-cloth and cordage, founderies, soap-woaks, and, in its vicinity, spinning mills and a cotton factory, are carried on to a small extent; and Dunbar has occasionally taken a share in the northern whale fishery; the herring fishery also employs a number of people in its season; but the town is chiefly supported by the export of corn, and the import of the articles required for the internal consumption of the county. In 1811, the town and parish of Dunbar contained a population of nearly 4000, and at present the number is stated at 4500.

h Ber-. The only other royal burgh is North Berwick, a sea-port to the north-west of Dunbar, nine miles from Haddington, and twenty-two from Edinburgh, having a population of about 800, with very little trade. North-Berwick-Law is a noted land-mark to mariners; two miles eastward, on a high rock surrounded on three sides by the sea, are the ruins of *Tantallan Castle*, formerly one of the strongholds of the House of Douglas, which was demolished by the Covenanters in 1639.

ges. The villages are Tranent, Prestonpans, noted for its salt-works and potteries, and formerly for an oyster fishery, Ormiston, Gladsmuir, Gifford, Saltoun, Aberlady, Cockenzie, Linton Bridge, Dirleton, and a few others.

Islands. The Bass, Craigleith, Fidra, Lamb, and Idris, are islets on the coast. The most noted of these is the Bass, a rock about a mile from the shore, a mile in circuit, and inaccessible on all sides, except the south-west. It has a spring of fresh water near the summit, affords pasture for a few sheep, and is frequented by great numbers of solan-geese and other sea birds. The situation of this small island occasioned it to be at different times a military station, a state prison, and a place of resort for pirates, down to so late a period as the Revolution.

Eminent Men. Haddingtonshire has produced men of eminence in various departments, among whom the names of Cockburn, Fletcher, Dalrymple, and several members of the Maitland or Lauderdale family, are conspicuous. Dunbar, the poet, was born at Saltoun in 1465; Burnet, the historian, was five years rector of the same parish. Blair, author of the *Grave*, and John Home, of the tragedy of *Douglas*, were ministers of the parish of Athelstaneford. George Heriot, the founder of the noble charity in Edinburgh which bears his name, was born in the parish of Gladsmuir; and here Robertson composed his *History of Scotland*. John Knox, the reformer, one of the most extraordinary men that any age or nation has produced, was born in the suburbs of Haddington in 1505. The house, the place of his birth, which, with a few acres of land adjoining, belonged to a family of his name till lately, is still pointed out to strangers.

Parishes. There are twenty-four parishes in this county, of which twenty-three belong to the presbyteries of Haddington and Dunbar, and one to the presbytery of Dalkeith. These presbyteries make a part of the synod of Lothian and Tweeddale. The poor are for the most part relieved by voluntary contributions; and where assessments have been found necessary, they have seldom exceeded $2\frac{1}{2}$ *per cent.* on the real rent, and this is paid in equal moieties by the landlord and tenant. Charities. There is a charitable establishment for the education of boys at Preston, which was founded by James Schaw, the proprietor of that estate, who died in 1784; and another at Saltoun, for the same and other objects, the work of Bishop Burnet, who bequeathed 20,000 merks for it in 1711.

Representation. The county of Haddington sends one member to Parliament, and the three burghs of Haddington, Dunbar, and North Berwick, join with Jedburgh and Lauder in electing another. Population. In 1755, the population, according to the returns made to Dr Webster, was 29,709; and, in 1811, it was 31,164, being an increase of about $4\frac{1}{2}$ *per cent.* in a period of 56 years. The numbers given by the writers of Sir John Sinclair's *Statistical Account of Scotland* denote a decrease, between 1755 and the years 1790–1797, of 743, the population at the latter periods being only 28,966. We annex an abstract of the census taken in 1800 and 1811. See Somerville's *Survey of East-Lothian*; *Beauties of Scotland*, Vol. I.; *General Report of Scotland*; Playfair's *Description of Scotland*, Vol. I.; and Chalmers's *Caledonia*, Vol. II.

(A.)

Haddingtonshire || Hampshire.

1800.

HOUSES.			PERSONS.		OCCUPATION.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
5851	7219	406	13,890	16,096	5346	3224	20,342	29,986

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
5882	7407	500	14,232	16,932	3130	2355	1922	31,164

Boundaries and Extent.

HAMPSHIRE, or, as it is sometimes called, the county of SOUTHAMPTON, or of HANTS, a shire of England on the British Channel. It is bounded on the east by Surrey and Sussex, on the north by Berkshire, on the west by Wiltshire and Dorsetshire, and on the south by the sea. Its extreme length is 55 miles, but, owing to a projection at its south-west extremity, its mean length is not more than 44 miles, and its breadth 39 miles. Its area, including the Isle of Wight, which is at the extreme points 23 miles long and 13 broad, is 1645 square miles, or 1,052,800 statute acres.

Population.

According to the returns under the population act, there were, in 1811, 44,240 houses, and 245,080 inhabitants, viz. 118,855 males, and 126,225 females. The number of families was 50,916. Of these 21,401 were employed in agriculture, 18,024 in manufactures and trade, and 11,491 in neither. The marriages were 2512; the males baptized were 4109, the females 4020. The deaths of males were 2897, of females 2718. That portion of the inhabitants living in towns, whose population exceeded 1000 souls, was 113,954.

Face of the Country.

As a whole, few counties in England are superior to this, or have a less proportion of uncultivated land. At the western extremity, bordering on Dorsetshire, a small portion of sandy heath is scarcely productive of any thing but sheep-feed, or of honey. A considerable tract, extending from Winchester to the northern extremity of the county, is down land, principally used for sheep-pasture, but, when brought under the plough, is very fertile in barley, turnips, clover, and sanfoin. Another portion is forest land,

Forests.

including the *New Forest* of about 92,000 acres, but within whose boundary a great part of the land is highly cultivated, and very fertile. The abundance of timber trees of large dimensions, the open glades between, and the variety of foliage, as well of the trees as of the underwood, render the scenery of the district highly delightful. The oaks are the principal beauty of this forest; they do not grow to a great height, but swell to large dimensions in the trunk, and shoot out strong crooked branches, which give them a very picturesque appearance, and add to their value as naval timber, by being well adapted to be used as knees for ships of the largest size. The beech trees also grow to a very great size, and contribute to the beauty, as well as the profits of the forest. The other forests are *Alice, Holt, and Woolmer,* extending over about 15,500 acres, of which nearly one half belongs to the Crown, and affords excellent oak timber; and *Bere* forest, of 16,000 acres, whose timber has been much neglected. In these forests there are abundance of deer belonging to the Crown, some of which are annually killed, and distributed, according to ancient prescription, to the various officers of the government and the royal household. The greater part of the county is inclosed, and even the down-lands are so in a great measure.

Rivers and Canals.

The principal rivers are the Itchen, which forms a part of the estuary of Southampton Water; the Avon, which falls into the sea at Christchurch Bay; the Boldre, which empties itself at Lymington. The Anton, which falls into the Tees, receives many small brooks before it reaches Southampton, where it is lost in that arm of the sea. The canals of the county are but two. The Basingstoke was begun in 1778, to communicate between that town and London. It is 37 miles in length, and terminates near Guildford, in the river Wey, which falls into the Thames. It passes through a tunnel, near three-quarters of a mile in length, under Grewell Hill, near Odiham. It was not completed till 1794: it had then cost L. 100,000; and the tolls are not yet sufficient to pay the interest. The Andover canal

shire. was begun in 1789 at that town, and terminates at Redbridge; and is useful to convey coals and other heavy commodities to the centre of the county.

ulture. The soil of this county is very various, but, in almost every part, it rests on a calcareous subsoil. The uplands are generally appropriated to breeding sheep, and hence the culture of turnips has been much extended. After the turnips are fed on the land, barley is usually sown, and with it clover, or other artificial grass-seeds. To the clover succeeds sometimes wheat or oats, and when the land is somewhat heavier in texture, occasionally beans; but in few parts of England are the rotations of crops more diversified. The average produce of corn on these high lands is not more than 16 bushels of wheat, 22 of barley, and 24 of oats to the acre. The ploughing is almost universally performed by horses, which are of a very excellent race. On much of the stiffer lands four of these strong horses are thought necessary; but on lighter lands, and with a single wheeled plough, sometimes two or three are used, and very rarely are harnessed abreast of each other. On the higher lands, the hay for winter consumption is generally made from sanfoin, a plant which peculiarly flourishes when the subsoil is calcareous. It is laid down with much care in extirpating all weeds, and every other description of grasses, and will usually continue for ten years to be fit for mowing, and on some soils it has been found to last even twenty years, and yield abundant crops of hay. There is no part of England in which this valuable grass is so well, or so extensively cultivated.

The corn lands on the lower levels of the county are much more productive; but on those districts they have no occasion for sanfoin, and scarcely for clover, as their rich water meadows supply them with a sufficiency of hay. Some of these meadows are perhaps the most valuable of any lands in this island, and are managed with great skill and attention. Where a rapid stream of water can be passed over them during the whole winter, it seldom becomes frozen; and the grasses grow during the cold weather, so as to be fit for pasture at an early period in the spring, before any traces of vegetation appear in the surrounding fields. This young grass is a provision for the sheep, when no other green food is to be found, and supplies them to the beginning of May, when it is laid up, and in six or eight weeks it is fit to be mowed, and yields most abundant quantities of hay. There is much of this valuable description of land in the fertile valley that extends from Overton to Redbridge, by Stockbridge.

In the eastern part of the county, bordering on Surry, there are extensive hop plantations, the produce of which is equal in flavour to those in the adjoining villages of that country near Farnham.

The original race of Hampshire sheep were white faced, with horns; but these have been so often crossed with other races, that few are left of an unmixed breed. Most of the flocks now are of the Southdown kind; they are found to be more beneficial, both on account of the superior quality of their wool, and the tendency to fatten with a less quantity of food than any others. The cows are not much attended to, and are not generally of the best kind. The introduction of the Welsh breed has made some improvement, but there is room for much more. Hampshire.

The breeding and fattening pigs has long been a most important part of Hampshire husbandry. The bacon from them is the principal animal food of the rural inhabitants. In the vicinity of the forests they are fed on acorns and beech-mast; and those so fattened are considered the best, either as pickled pork, or when converted into bacon. The average weight of these animals, when deemed fit for slaughter, is about 440 or 450 pounds, but many of them weigh 800 pounds.

The manufactures of this county are neither numerous nor extensive, except those carried on at Portsmouth, for warlike purposes. Besides the shipbuilding in the royal yard, there are many vessels, both for war and trade, built on the River Itchen at Buckler's-hard, on the River Boldre, and on the banks of Southampton Water. The manufacturing of their woollen goods upon a small scale is carried on at Andover, Romsey, Alton, and Basingstoke. Paper is made at Rumsey, and at Overton. The mills at the latter place have supplied the whole of the thin paper used by the Bank of England for their notes, ever since the reign of George I. Ringwood has been long celebrated for the excellence of the strong beer brewed there; but the quantity has declined of late years. On the sea shore at Lymington, and on the island of Hayling, near Havant, some salt is made by the evaporation of sea-water. The quantity depends on the degree of heat which prevails during the summer season, as the first part of the process of evaporation is performed by the heat of the sun alone; the brine is afterwards conveyed to iron pans, and the process completed by artificial heat, which, as coals, the only fuel, are dear, makes the whole expensive, and prevents the proprietors from competing with the northern manufactures of salt. Manufactures.

The foreign commerce of the county is inconsiderable. Many merchant-ships repair to Portsmouth, with stores for the naval arsenal, and, in time of war, many prizes are carried there for sale, which creates some extensive trade. Southampton imports much wine from Portugal, which, before the introduction of the bonding system, used to be deposited in the islands of Guernsey and Jersey, to save the interest on the amount of the duties. At Christ-Church there are a few vessels fitted for the Newfoundland fishery. Commerce.

The most populous town in the county is Portsmouth, which, with its adjuncts, Portsea and Gosport, with the adjacent villages, contains between fifty and sixty thousand inhabitants. The far greater part of these are the families of officers of the navy, army, and marines, and of the arsenal, with the various artificers.

The harbour of Portsmouth is perhaps one of the best in the world. Its entrance is narrow, and, therefore, easily defended. The approach to that entrance is defended by batteries, that can rake any ship before it reaches the fire of the castles, at the Portsmouth.

Hampshire.

two narrowest points. The depth of water is sufficient for the largest ships, and the interior spreads out into an extensive basin of still water, in which there is room for all the British fleet to anchor. The system of building no ships of war in private yards has much increased the number of artificers of every description. The mast-making, anchor-making, cable-making, and particularly the making of blocks, are all conducted within the walls of the arsenal, which, as a whole, is a most astonishing combination of vast powers simply and economically directed to naval purposes. The Gun-wharf, Victualling-office, the King's-mill, and many other public buildings, merit rather a detailed description, than such brief notices as our limits allow. One of the finest objects depending on the naval establishment is the hospital for sick and wounded seamen at Haslar. It is 567 feet in length. It is divided into 100 wards, each sixty feet long, and twenty-four broad, calculated to receive twenty patients, with apartments adjoining for nurses and attendants.

Southampton.

Southampton is celebrated for the beauty of its environs, the elegance of the streets and buildings, and the purity of its air; and is much frequented for salt water bathing, and on account of a chalybeate spring of considerable repute. In the summer season it is a place of fashionable resort to those who wish to enjoy the rides among the pleasing scenery of the New Forest.

Winchester.

Winchester, a city of ancient date, has fallen to decay, and now depends on its being the county town, the see of the bishop of an extensive diocese, the station of his courts, and a collegiate place, in which many youths of the first families in the kingdom receive their classical education. The cathedral and the castle are venerable piles of antiquity, though the former was much damaged, and the latter blown up by the soldiers of Cromwell, after his capture of the city.

Antiquities.

The antiquities of this county are very numerous; they are to be contemplated in the ruins of numerous castles, abbeys, and shattered towers, which add not a little to the beauty of the scenery. The most remarkable of these are Calshot Castle, Netley Abbey, Hurst Castle, Porchester Castle, and Beaulieu Abbey. Antiquities of more early date,—of ancient British or of Roman origin, are scattered over the county. The numerous barrows are ascribed to the former, and many vestiges of entrenched camps and castles to the latter.

The beauty of the country has attracted to it a greater number of families of rank and fortune than almost any other county can enumerate; the bare list of which would fill a page.

The towns and their population are as follow:—

* Portsmouth and Portsea,	40,567
* Southampton,	9,617
Gosport,	7,788
* Winchester,	6,705
Romsey,	4,297
Farnham,	3,325
* Andover,	3,295
Ringwood,	3,269
Titchfield,	3,227
Basingstoke,	2,656
* Lymington,	2,641
Alton,	2,313
Fordingbridge,	2,259
Kingsclere,	1,863
Bishops Waltham,	1,830
Havant,	1,824
* Christchurch,	1,553
Hambledon,	1,495
* Petersfield,	1,280

Two members are returned for the county, two for each of the towns marked with an asterisk, and for the smaller towns of Stockbridge and Whitchurch.

Isle of Wight.

The Isle of Wight, a part of Hampshire, is not noticed in the preceding account, because it is a division of itself, and insulated from the rest of the county. The whole is an agricultural district, and produces most abundant crops of corn, usually estimated to be from eight to ten times as much as its inhabitants consume. It is almost divided into two equal parts, by the navigable river Medina, on which are many vessels, converted into floating tide-mills, for grinding wheat. Besides its agricultural productions, it affords fine sand, much used by the glass makers, and a white pipe clay. It returns two members to Parliament for each of these places, —Newport, Yarmouth, and Newton. The towns and population are, Newport, 3855, Cowes, 3325, Ride, 1601, and Brading, 1218. The whole population of the island in 1811 was 24,120.

See Brayley and Britton's *Beauties of England and Wales;* Driver's *Reports to the Board of Agriculture;* Milner's *Winchester; Hampshire Repository;* Warner's *Walk through Southampton;* Worsley's *Isle of Wight.* (W. W.)

Hampshire ‖ Hanover.

HANOVER, a kingdom in Germany, formerly an electorate, whose princes were raised to the throne of Great Britain. It was seized by France during the late war, and delivered over to the King of Prussia. After the battle of Jena France resumed her authority over it, and transferred it to Jerome Bonaparte, to compose a part of his newly created kingdom of Westphalia. In the year 1814, the dissolution of the French power gave back this country to its former sovereign. In 1815 it was increased by the addition of several dominions, and erected into a kingdom, which assumed the name of its capital city.

Boundaries and Extent.

By subsequent treaties with Prussia and Denmark, which exchanged territory, Hanover has become a compact dominion, extending over 14,720 English square miles. It lies between 50° 18′ and 53° 54′ north latitude, and 6° 58′ and 11° 56′ east longitude. It is bounded on the north by the Duchy of Oldenburg, the Bailiwick of Ritzebüttel, belonging to Hamburg, and the mouth of the Elbe. On the north-east the river Elbe divides it from Holstein and Luneburg, belonging to Denmark, and from the Duchy of Mecklenburg Schwerin; only

Hanover.

that it has the small territory of Neuhof on the right bank of that river. On the east it is bounded by the Prussian province of Saxony, and by the Duchy of Brunswick; on the south it touches the dominions of Prussia, of Hesse Cassel, of both the Lippes, and of Westphalia; on the west the kingdom of the Netherlands is the boundary.

Divisions and Population.

This kingdom is divided in the following manner:—

	Population.	Extent in Eng. acres.	Capitals, and their Population.	
Principality of Kalenburg - -	139,222	680,960	Hanover	24,000
of Göttingen - -	96,593	440,320	Göttingen	8,970
of Grubenhagen -	80,300	330,240	Eimbeck	4,990
of Lüneburg - -	252,450	2,794,240	Lüneburg	10,050
County of Hoya, with Diepholtz	104,970	908,160	Nienburg	3,420
Province of Bremen - - - -	191,060	1,720,320	Stade	4,740
of Osnabrück - - -	188,655	1,169,930	Osnabrück	9,280
of Hildesheim - - -	121,816	426,880	Hildesheim	10,650
of East Friesland - -	127,522	721,920	Emden	10,980
of Bentheim - - -	24,364	182,620	Bentheim	1,380
of Hohnstein - - -	6,680	33,200	Ilefeld	620
	1,333,632	9,408,790		

The most considerable places, besides the capitals of the provinces, within the kingdom, and their respective populations, are Hameln, 5050; Nordheim, 3100; Münden, 4500; Osterode, 4180; Duderstadt, 4100; Elbingerode, 2380; Klausthal, 7100; Uebzen, 2550; Zell, 8360; Verden, 3520; Altenbruch, 2320; Pappenburg, 3250; Goslar, 5670; Alfeld, 2100; and Aurich, 2660. The principalities of Kalenburg, Göttingen, and Grubenhagen, and a part of Hildesheim, are very mountainous, especially in the southern divisions. The other provinces form a part of that extensive plain which commences on the shores of the German Ocean, and terminates on the frontiers of Russia. The whole plain is a sandy soil, resting on a bed of granite, and is generally sterile, except on the banks of the various rivers that water it, or near the cities, where cultivation has improved it by artificial means. The most fruitful part of the kingdom is on the banks of the Elbe, and near the German Ocean, where, as in Holland, rich meadows are preserved from being immersed in water, by broad dikes and deep ditches, constructed and kept in repair at a great expence.

Mountains.

The most remarkable mountains are those of the Hartz Forest, three-fifths of which are in this kingdom, and two-fifths in the Duchy of Brunswick. These mountains are not a part of any chain, but rise from a plain in a groupe by themselves, the highest points of which are nearly in the centre. The mass is about eighty miles in length from east to west, and about twenty-eight in breadth from north to south. The highest points, and their height above the level of the sea, are Bruchberg, 3020 feet; Wormberg, 2880 feet; Achtermanshöhe, 2710 feet; the little Winterberg, 2684 feet; Kahlenberg, 2180 feet; and the Rammelsberg, 1915 feet. These mountains are wholly covered with forests. On their lower sides the trees are of the deciduous kinds, but the summits are exclusively pines. These mountains abound with minerals of almost every kind, and the principal employment of the inhabitants is either in mining, or in manufacturing the iron and copper into domestic utensils. Some of the mining and manufacturing towns, as Klausthal, Andreasberg, Cellerfeld, and several others, are from 1700 to 1900 feet above the level of the sea; and their population would suffer most severely from the cold of the severe winters, but for the abundance of both wood and fossil coal with which they are supplied.

Rivers.

The whole of the kingdom of Hanover dips towards the north, and the courses of all the rivers are in that direction. These are, *first*, the Elbe, which borders a large part of the dominion, and receives into it the Ohre, which rises in the province of Luneburg; the Aland and the Jeetze, which come out of Prussia, and are navigable before they terminate in the Elbe; the Ilmenau, which becomes navigable at Luneburg; the Este, which is navigable to Buxtehude; the Lühe, navigable to Hornburg; the Schwinge, by which vessels reach Stade; the Oste, which passes Harburg, and is navigable to Kirchosters; and the Medem, which runs through the land Hadeln, and admits large vessels as high as Ottendorf. *Second*, the Weser, which enters the dominions of Hanover at Münden, being there formed by the junction of the Fulda and the Werra. It is navigable for barges from the spot at which its name commences. It receives, in its course, the Hamel, the Aller, the Oertze, the Line, the Böhme, the Eyther, the Wümme, the Lesum (formed by the three streams, Rodau, Wiste, and Worpe), the Greste and the Hunter; all of which are Hanoverian rivers, and continue their united courses till they are lost in the German Ocean near Bremen. *Third*, the Ems, a river rising in the Prussian province of Westphalia. After entering Hanover, it receives the waters of the Aa, the Hase, the Else, and the Leda. Before reaching the sea, it falls into the Dollart near Emden, which is the principal sea port in the kingdom. The vessels belonging to this port are about 270, and their tonnage 19,289 lasts. There are equipped at the mouth of this river upwards of fifty

busses, which are employed in the herring-fishery, and usually take and cure from 12,000 to 14,000 tons of that fish annually. *Fourth*, the Vecht, a river of short course, rising in the Prussian province of Westphalia, and terminating in the Zuyder Sea. Its principal importance is derived from a navigable canal, which commences at the city of Münster, and is the channel of some trade through the Vecht to Amsterdam.

Lakes and Canals.

Though Hanover is generally a sandy soil, it has some small fresh water lakes. The Dummersee, in Diepholtz, is about twelve miles in circuit. The Steinhudermeer, in the province of Kalenburg, is about four miles long and two broad; and the Dollart, at the mouth of the Ems, which is rather an estuary than a lake, is twelve miles across. The canals are all of short course. The Bremen canal, designed to unite the Hamme, the Oste, and the Schwinge, is not completed; nor is the Treckschuit canal, intended to connect Witmund with Aurich. The Pappenburg canal is only navigable from the Ems to that city.

Rural Economy.

Though considerable variations, in conformity to the different natures of the soils, occur in the husbandry of Hanover, yet it may be generally described as at a very low standard. The land mostly belongs either to the king or to the nobles, as lords of the soil, who have under them a species of tenants called bauers, having the use of small portions of land, under many and various feudal conditions. These bauers pay little or no rent in money, but render the lord a stipulated number of days' work in seed time and harvest on his demesne lands, or give him a certain proportion of the proceeds of their crops. In most instances the lords have the right of pasture for their cattle over the whole land, and are the proprietors of most of the sheep and cows. There is an exception to this mode of holding, called the *meyer law*, but it extends over so small a portion of the kingdom, as not to merit a detailed notice of it. The rotation of crops usually followed in Hanover is first a fallow, on which the land is cultivated to potatoes, peas, or flax; then follows winter corn, either rye or wheat, but chiefly the former, and to them succeeds summer corn, either barley or oats. As the fields are usually divided into small portions, like many of our common fields in England, and the larger divisions must all be cultivated alike, though belonging to different occupiers; and as the course that has prevailed from time immemorial must be continued, there is little or no room for improvement, and little encouragement for superior knowledge or greater activity. Such is the bad state of cultivation, that the increase of grain is not estimated to exceed four for one of the quantity sown through the whole kingdom. The breeding and fattening of cattle is a branch of rural economy, confined to particular portions adapted to that purpose, and is in the same backward state as the agriculture. By the latest enumeration of the live stock, which was previous to some provinces of 600,000 acres in extent being added to it, there were 224,500 horses; 675,926 head of horned cattle; 1,540,794 sheep and lambs; 15,728 goats and kids; 176,974 swine; and 1498 asses and mules. Much of the heath land, especially in the province of Luneburg, is used for no other purpose but that of rearing bees for the sake of their honey and wax. The hives are transported in waggons, at the commencement of the spring, to those more southern countries, where the flowers bloom early, and are afterwards brought back when the heath flowers are fit for them, and remain till the proper time for taking the contents of the hives. Large numbers of geese are also kept by the bauers on the moist situations; their flesh is salted for winter domestic consumption, and their feathers are preserved for sale. These two sources, affording wax, honey, and feathers, yield the principal disposable produce of some of the provinces.

Manufactures.

The manufactures of Hanover are very numerous, but none of them extensive. Except linen, linen yarn, and domestic utensils, few of them afford a surplus beyond the home consumption. The linen is of four kinds: First, that called *Hauseleinwand*, or household linen, the making as well as use of which is to be met with in every family. Second, a coarse kind, that called the *Lowentleinen*. Third, the fine linen, which is only made in some of the cities to a small extent, and almost wholly consumed by the richer families of the kingdom. Fourth, sailcloth and hempen linen, which is principally made in East Friesland and the Duchy of Bremen, and which is mostly sold for foreign consumption. Besides the linen yarn used in the home fabrics, a great quantity is spun for foreign trade. Spinning is, indeed, the constant operation of almost all the females in the villages during the long nights of winter. The spinning of coarse wool, and making it into cloth, either by itself or mixed with linen, occupies a considerable portion of the industry of the peasantry, and furnishes them with clothing from the produce of their own lands; besides these, they spin cotton, and, mixing the yarn with that of linen, manufacture dresses for the females and the younger part of their families. The stockings they wear, whether of linen, cotton, or worsted, are usually made at home. In some parts of the country much oil is made from linseed. Coarse pottery ware is made in many parts. Paper-mills, which supply about 80,000 reams annually, are not sufficient for the home consumption. In the cities, woollen cloths, silk goods, cotton of various kinds, hats, hosiery, soap, and leather, are manufactured. The principal branches that employ much capital, are the breweries of Hanover, Embeck, and Goslar, and the corn distilleries which are to be found in all the cities. The former of these are suffering a gradual declension, whilst the latter are as rapidly increasing.

Minerals.

The productions of the mines naturally follow those of agriculture and manufactures. These yield annually as follows;

Silver,	34,238	merks, valued at		410,436 rix dollars.
Copper,	1404	hund.		44,928
Lead,	41,949	do.		258,624
Iron,	122,913	do.	valued, including the labour of what is manufactured at the mines,	484,347
Zinc,	2987	do.		44,805
Vitriol, white, blue, and green,	1289	do.		3878
Sulphur,	1300	do.		866
Salt,	329,055	do.		548,425
Fossil coal,	469,840	do.		58,730

The prices at which the commodities are estimated are those which they are worth at the mines, before any expence of carriage has been incurred.

merce. As may be supposed from the small quantity of surplus production, the trade of Hanover cannot be extensive. The principal port, Embden, has some export and import trade; but from the state of the roads between that place and the more populous parts of the kingdom, more of its trade passes through Hamburg and Bremen than through that city. Besides the more considerable articles made from flax, its honey, wax, feathers, and large quantities of timber, are sent to Hamburg and Bremen. Hops, rape-seed, oil-cake, fruit, hams, and sausages form also articles of export of small amount. In very fruitful years some corn is exported, but in general the consumption is equal to the produce. The imports consist principally of wine, coffee, tea, sugar, indigo, tobacco, and a few manufactured articles, which are consumed by the richer classes. As the roads to the great fairs of Leipsic and Frankfort pass through Hanover, the transit of goods by these create a pretty large commission trade, and give employment to many waggons, horses, and men, as well as to the barge owners. The exports and imports nearly balance each other, and the amount of neither exceed L. 500,000 Sterling.

vern- at. The government of Hanover is a monarchy, whose king is the possessor of the throne of Great Britain. Before it was erected into a kingdom in 1814, the dominions consisted of various portions, the succession to which was regulated by ancient and different usages; but at that epoch the whole was made subject to the same law of succession, and the different parts cannot be henceforth divided. In case the present family should become extinct, the heir of the house of Brunswick is to succeed to the sovereignty. The monarch is deemed to be of age when 18 years old. During a minority, the states of the kingdom are guardians, unless the case is provided for by the predecessor. The king has the whole executive power,—the appointment of officers, civil, military, and judicial. The legislative power is enjoyed jointly with the assembly of the states. This assembly consists of 102 deputies, chosen for the three bodies of the clergy, the nobility, and the cities. Those who are supposed to represent the clergy are nominated by the chapters of the secularized religious foundations; the nobility choose their deputies; and the magistrates of the cities select theirs. In a country where scarcely any men of much information are to be found out of the privileged classes, it is not surprising that nearly all the deputies should be chosen from them. The ministry are supposed to have the nomination of the greater number of the members, and three-fourths of them have places under the crown. The deliberations are secret, and the result of them only known by the laws they promulgate. The members, during their sittings, are allowed some pay. Those who reside in the city of Hanover have two, and those who come from other places have four, rix dollars daily subsistence money. The administration of the executive part of the government is at present in the hands of a prince of the royal family, with the title of Governor-General, and a salary of L. 5500 Sterling. He is assisted by various ministers, forming a cabinet-council, who administer, at the head of respective boards, the different branches of the public business.

The finances of the kingdom are not stated to the public, and therefore cannot be accurately known. The revenue is estimated to amount to about one million Sterling, of which a little more than L.500,000 is derived from the patrimonial estates of the king, who is by far the largest land-owner in his dominions; the remainder is drawn by taxation. The taxes are—a land-tax, producing L.170,000; a tax on food consumed in towns and cities, L.20,000; a tax on brewing and distilling, L.67,000; on salt, L.20,000; on stamps, L.5000; on imported goods, L.33,000; and a property and personal tax, L.92,000. This can only be an approximation to accuracy; but it is certain that the taxes produce less than the domains. The estates of the king and of the nobility were formerly exempt from many of these taxes, but now all are alike liable to them. Revenue.

The national debt of Hanover is about three years income, or somewhat more than L.3,000,000 Sterling. A part of this was owing before the occupation of the country by France; but, during the period they were in possession, it was much increased; and the preparations made for war when Bonaparte returned from Elba caused a farther augmentation. The interest is paid at the rate of four *per cent.*, and the debt has been diminished within the last four years. It is almost wholly owing to the subjects of the kingdom. Debts.

The regular forces of Hanover amounted to 12,940 men and officers, but they are undergoing a reduction, which is intended to bring them to less than 8000 for a permanent peace establishment. The militia, or landwehr, have hitherto been 18,000; but they are, like the regulars, gradually reducing, Forces.

and will be fixed at about two-thirds that number. Hanover has no naval force, except a single brig of war, moored off the city of Stade, to enforce the tolls which all merchant vessels passing up the Elbe are bound to pay, and which amounts to about L.5000 Sterling annually.

Judiciary System. The judiciary system of Hanover is very complicated. Many of the inferior judges and magistrates are appointed by the proprietors of particular estates; and many of those nominated by the king are rather by his prerogative as owner of some estates than as the monarch. Some of these jurisdictions are small, but yet have the power of life and death. An attempt is now making to simplify and assimilate the administration of justice in the different provinces, among which there is considerable variation. It must, however, be a work of time, as the inhabitants are much attached to their local customs. A court of appeal at Zell has extensive power, and it is intended to increase its authority by allowing all the provinces to have recourse to it for final judgments.

Religion. In Hanover there is not merely toleration, but equal establishment to the three Christian sects of Lutherans, Catholics, and Reformed; and the smaller sects of Menonites, Hernhuthers, and others, enjoy perfect protection. The members of the Lutheran community amount to 1,050,000; the Catholics to 160,000; the Reformed to 90,000; the remainder comprise Jews and the smaller Christian communities. The Lutheran church is regulated by superintendents, who resemble bishops, but are assisted, and somewhat controlled, by the consistories. The seat of these is in Hanover, Stade, Osnabrüch, Hildesheim, Aurich, and Hohnstein. The Catholics are divided into dioceses, and have bishops at Osnabrüch, Hildesheim, and Regersburg; and the provinces of Meppen and Eimsbuhren are under the spiritual jurisdiction of the Prussian Bishop of Münster. The Lutherans and Reformed are united in some of the consistories, and the trifling differences in their faith and modes of worship are easily compromised or reconciled.

Education. The means of education are very amply provided for all classes of the community. Each village has a schoolmaster for gratuitously teaching the poorer inhabitants; all of whom are instructed in reading, writing, and the common rules of arithmetic. In the capital there is a large institution, established for the tuition of the parochial schoolmasters. In all the cities, and many of the towns, are Gymnasiums, in which classical and elementary instruction is dispensed on very moderate terms. The University of Göttingen, established by King George II. in 1734, has been greatly celebrated for the learning of its professors and the number of its pupils. Owing to some turbulent conduct of the latter, their number has been reduced from 1200 to 800, none of whom are either subjects of Hanover, of Hesse Cassel, or of Brunswick. The library belonging to the university is admirably conducted, and consists of near 300,000 volumes. There is a valuable chemical, mechanical, and philosophical apparatus; an astronomical observatory; and dissecting rooms for surgical and veterinary studies. The university is governed by its own magistrates, and the professors may publish what works they please, without a previous censurate being exercised.

The press in Hanover is not, however, unrestricted. All works, except those of the Göttingen professors, must be examined and licensed before publication; but the censors are very liberal in the exercise of their duty, and seldom suppress any works, however contrary to established opinions, if they are unmixed with slander, invective, or personalities. There is no law in Hanover to prevent the introduction of any work, however obnoxious, that is published in other parts of Germany, or in foreign countries.

Poor. The poor are provided for wholly by voluntary contributions, which are made from house to house at stated periods. They are in a great degree supported in workhouses, where their own labour contributes in some measure to their maintenance. Their food and clothing are of the coarsest kind. There are many hospitals and other charitable establishments for the relief and cure of the diseased; and, upon the whole, the poor are as well taken care of as in other countries where their maintenance is compulsory.

Births and Deaths. By the population tables, which are accurately kept, the increase in the number of inhabitants is going on rapidly. In the year 1817, the births were 46,118, and the deaths 32,004, though, on account of the scarcity of corn, the greatest distress was felt; of these births the males were 23,812, and the females 22,314.

Language. The language usually spoken in Hanover is the Plat-Deutsche, a dialect of the High German, more pure, and less complicated in its construction, but treated by the learned with more contempt than it merits. As the service in the churches and the instruction in the schools is exclusively in the High German, all the peasantry understand it, though they very unwillingly use it when they can avoid it. The higher classes pride themselves on speaking the High German with greater purity than is practised in any other part of the empire.

Money. Hanover has two standards of money, the Leipsigen and the Convention. The public accounts are kept in the latter. The gold coin called Georgs d'or is five rix dollars eight groschen in convention money; or, in Leipsigen money, four rix dollars sixteen groschen. The other gold coin, the Gold-Gulden, is two rix dollars six groschen in convention, two dollars two groschen in Leipsigen money.

Weights and Measures. The long measure is the rood of eight ells; the ell is two feet; the foot twelve inches. Six Hanoverian are equal to five Brabant ells. Land is measured by hufen and morgens. The hufe is 30 morgens, the morgen 120 ruthen, equal to 24.844 Paris feet. The morgen by which woodland is measured contains 160 ruthen. The liquid measure is the eimen, of 3,136 cubic inches, or the anker of 1.960 cubic inches. The latter makes 16 stübchens, or 32 kannen—64 quartiere, or 128 nosel. The weights in common use are ships-pounds, lies-pounds, hundreds, and customary pounds. The ships-pound is equal to 20 lies-pounds; the hundred is 110 lies-pounds.

Hanover. Heberden.

The lies-pound is divided into two marks, the mark into eight ounces, the ounce into two loths, the loth into four quentins. The local weights and measures vary from these the standards in all the villages of the several provinces.

See *Erdebescreibung des Konigreichs Hannover,* von H. D. A. Sonne. *Historish-Topographisch-Statistische Bescreibung der Königlichen residentz-stadt Hannover,* von B. C. Spilcker. Hodgskin's *Travels in Germany.* Jacob's *Travels in Holland and Germany.* (w.w.)

HEBERDEN (William), a practical physician of great celebrity, was born in London in the year 1710. He was sent at a very early age, near the end of 1724, to St John's College, Cambridge. He took his first degree in 1728, and obtained a fellowship about 1730; he became M. A. in 1732, and M. D. in 1739. He remained at Cambridge about ten years longer as a practitioner of physic, and gave an annual course of lectures on the Materia Medica. In 1746 he became a Fellow of the Royal College of Physicians in London, and two years afterwards he left Cambridge, having presented to St John's College the specimens which had been subservient to his lectures. He also added to this donation, a few years afterwards, a collection of astronomical instruments of some value. Having determined to establish himself in London, he was elected a Fellow of the Royal Society in 1769; and he was employed in a very extensive medical practice for more than thirty years. When he became sensible that his age required some indulgence, he resolved to pass his summers at a house which he had taken at Windsor; but he continued his practice in the winter for some years longer. In January 1760 he married Mary, daughter of W. Wollaston, Esq., by whom he had five sons and three daughters; but he survived them all, except the present very respectable Dr W. Heberden, and Mary, married to the Rev. G. Jenyns. In 1778 he was made an honorary member of the Royal Society of Medicine at Paris.

Dr Heberden's *first* publication seems to have been a short essay on the incongruous composition of the mithridate and theriac, entitled *Antitheriaca.* 8vo. 1745. 2. He sent to the Royal Society an *Account of a very large Human Calculus,* weighing more than $2\frac{1}{4}$ pounds avoirdupois. *Ph. Trans.* XLVI. 1750, p. 596; *Abr.* XI. p. 1005. 3. *Account of the Effect of Lightning, at South Weald in Essex. Ph. Trans.* LIV. 1764, p. 198. Both these essays are erroneously attributed, in Dr Maty's index, to his brother, Dr Thomas Heberden of Madeira, who sent several other papers to the Society. Dr Heberden was one of the principal contributors to the first three volumes of the *Medical Transactions,* published in a great measure at his suggestion, by the College of Physicians, in which we find about sixteen of his original communications. 4. *Remarks on the Pump Water of London.* I. 1768, p. 1. 5. *Observations on Ascarides,* p. 45, 54. 6. *On Night Blindness, or Nyctalopia,* p. 60. 7. *On the Chicken Pox,* p. 427. 8. *On the Epidemical Cold of* 1767, p. 437. 9. *Queries,* p. 499, relating to bark, camphor, cold, the gout, and apoplexy. 10. *On Hectic Fever,* II. 1772, p. 1. 11. *On the Pulse,* p. 18. 12. *On a Disorder of the Breast,* p. 59,—the *angina pectoris.* 13. *On Diseases of the Liver,* p. 123. 14. *On the Nettle Rash,* p. 173. 15. *On Noxious Fungi,* p. 216. 16. *Queries,* p. 499, on sizy blood, on hernia, on damp clothes, and on venesection in hemorrhages. 17. *On an Angina Pectoris,* III. 1785, p. 1. 18. *On the Ginseng,* p. 34. 19. *On the Measles,* p. 389. 20. *Table of the Mean Heat of the different Months in London. Phil. Trans.* LXXVIII. 1778, p. 86. 21. *Commentarii de Morborum Historia et Curatione.* 8vo. Lond. 1802. Also in English. He had long been in the habit of making notes in a pocket-book, at the bedsides of his patients; and every month he used to select and copy out, under the proper titles of the diseases, whatever he thought particularly worthy to be recorded. In the year 1782 he employed himself in digesting this register into the form of a volume of *Commentaries* on the history and cure of diseases, religiously observing never to depend on his memory for any material circumstance that he did not find expressly written down in his notes. These commentaries were entrusted to the care of his son, Dr W. Heberden, to be published after his death. We find in them a greater mass of valuable matter, accurately observed and candidly related, than in almost any other volume that has ever appeared upon a medical subject; yet they are but too likely to chill the ingenuous ardour of many a youthful mind, and even to lead to a total apathy with respect to the diligent study of a profession in which so respectable a veteran was so often disposed to exclaim, that "all is vanity." There are indeed many instances in which he does not seem to have been perfectly master of all the instruments of his art; thus, he appears to have been but partially acquainted with the virtues and various uses of antimony and ipecacuan, and to have reasoned very inaccurately on the operation for a strangulated hernia. But it has been remarked, that the more experience a physician acquires in his profession, the more he is in general inclined to approach to the opinions of Dr Heberden, and to esteem his writings.

Notwithstanding that he has been accused of having occasionally been liable to personal and professional prejudices, it may safely be asserted, that he possessed a singular combination of modesty and dignity of character. He was not only a well-informed and accomplished scholar, but a man of the purest integrity of conduct, of mild and courteous manners, distinguished by genuine piety, and by unaffected benevolence of heart. It is related by one of his biographers, that he bought a sceptical work, left in manuscript by Dr Conyers Middleton, of his widow, for L.50, in order to burn it. He was at the expence of publishing another work of the same author, on the servile condition of physicians among the ancients, as well as an edition of some of the plays of Euripides, by Markland. He had an opportunity of rendering an essential service to Dr Letherland, a man of the deepest and most extensive learning and science, that adorned the last century, but of retired habits, and very little known even in his profession, though he contributed by his

literary information to the popularity of more than one of his colleagues. Dr Heberden's extensive practice made it inconvenient for him to accept the appointment of Physician to the Queen; and the King, who had always shown him the greatest esteem and regard, readily adopted his disinterested recommendation of Dr Letherland as his substitute in the situation. He died 17th May 1801, at the age of above 90 years, having exhibited, at the close of his life, the same serenity of mind which he had enjoyed throughout its course. (*Life* prefixed to his *Commentaries*, Chalmers's *Biographical Dictionary*, XVII.) (F. O.)

HELIGOLAND, or HELGOLAND, a group of small islands in the North Sea, belonging formerly to Denmark, now to Great Britain, and situated about 28 miles from the mouths of the Weser, the Elbe, and the Eyder. It consists of the principal island, subdivided into the Cliff and the Low Land; the smaller island, called the Down; and several sand-banks and rocks, of which that called the Monk is the most conspicuous. The Cliff is a continued rock of sandstone (red breccia), almost perpendicular, varying from 90 to 166 feet in height; the ascent to it is by a long flight of steps; its circumference is above 4000 paces. While the Cliff is said to suffer progressive diminution from the action of the waves, the Low Land is asserted to be on the increase. It is joined to the former by a bottom of rock, about 500 paces long. Its circumference is much smaller than that of the high ground; and the circuit of the whole island does not exceed two miles and a half. The Down, or Downs, is not quite half this size; but its extent is continually varying. On the High Land is a light-house, whose geographical position is 7° 53′ 13″ east longitude, and 54° 11′ 34″ north latitude. It is of great use to guide ships, not only amidst the surrounding rocks and shoals, but being visible at a distance of more than 27 miles, serves as a mark for directing vessels to the mouths of the nearest rivers on the continent.

Heligoland has two good harbours; and to the east of the Down is a road where vessels may anchor in 48 feet of water. The inhabitants, in number above 2000, subsist chiefly by fishing and acting as pilots; the women cultivate the little grain (barley and oats) that is raised here, and attend to a few hundred sheep, for which there is pasture on the upper ground. It is in this part of the island that the public and other buildings are placed; on the low grounds there are only fishermen's huts. There are two wells of fresh water, but scarcely a tree or shrub of any kind on the island. Turf, wood, fuel, and garden vegetables, are brought from Cuxhaven and Hamburgh in exchange for fish.

Heligoland was, in former ages, of much greater extent; having been, it is said, the residence of a chief of the Sicambri, or North Frieslanders, and the seat of worship of the Saxon deity Phoseta. The latter is confirmed by the name, which signifies in German "sacred land." The diminution of the island has taken place at different times; in the years 800 and 1300, if tradition may be believed, but with certainty in 1649, and even in 1720. The ravage of 1649 seems to have been very considerable. In our late war with the Danes, it was taken by a small squadron in September 1807, and rendered a depot for merchandise, which was smuggled afterwards into the ports of the continent, from which our commerce was excluded by Bonaparte. At that time Heligoland was much crowded with mercantile adventurers. At the peace of 1814, though exclusion was no longer to be dreaded, our government judged fit to retain the island, doubtless in consideration of the value of its double harbour, and of the ease with which the high ground may be defended. —*Edinburgh Gazetteer*.

HERCULANEUM. Referring the reader to the *Encyclopædia* for some account of the discovery and antiquities of this city, we propose in the present article to direct his attention to the attempts which have been made to recover the literary treasures, long retained in a state intermediate between existence and annihilation among its ruins. The few successful results of the investigation, which have hitherto been laid before the public, are, indeed, of such a nature as not to have rewarded, by their importance, the great labour which has been bestowed on them. But the zeal of the lovers and patrons of literature has not allowed their ardour to be subdued by the difficulties of the task. His present Majesty, GEORGE the FOURTH, is well known to have distinguished himself, in the early part of his life, by the munificence which he displayed in sending over a native of this country to superintend and remunerate the operations which were slowly and patiently conducted upon the manuscripts at Naples; and, in the course of the last few months, one of the most illustrious ornaments of British science, supported by a similar liberality on the part of our government, has been engaged in far more rapidly bursting the fetters of the imprisoned authors, by the masterly touch of his magic wand.

The progress of the discovery and examination of these singular remains of antiquity has been described, from time to time, in the *Philosophical Transactions*, and in many other publications. It was in October 1752 that the first of the carbonised rolls of papyrus were found: and Paderni's account of them is accompanied by an interesting specimen, which exhibits the genuine form of the characters used by the Romans in their manuscripts.

N·ALTERIVS·DVLC
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The precise spot where the discovery was made was the Bosco di Sant' Agostino, a shrubbery belonging to the church of St Austin, close to Portici, towards Torre del Greco: it was covered with ashes, and a hard tufa or lava, to the depth of about 120 English feet. In the course of a year or two about 250 rolls had been found, some Greek and some Latin. The library appeared to be an apartment belonging to a considerable palace, which had not been further examined. The floor was of an elegant mosaic work: the books were in presses, inlaid with different sorts of wood, disposed in rows, and ornamented with cornices. In 1754, Paderni spent twelve days in this room, and found in it

337 volumes, all apparently made brittle by the fire, and all in Greek; besides, eighteen rolls of a larger size, lying in a separate bundle, which were in Latin, and were more injured than the Greek. The former 250 seem to have been in a separate room, belonging to the same building. Some few of the rolls had an umbilicus or roller of wood in the centre. The canon Mazzocchi began his labours about this time, and found that the subject of one of the manuscripts was *Music*, and that of another the *Epicurean philosophy*: a small bust of Epicurus having also been found in the same room.

In 1755, a further account of these operations was communicated to the Royal Society by Mr Locke. "Within two years last past," says his correspondent, "in a chamber of a house, or, more properly speaking, of an ancient villa, for by many marks it is certainly known, that the place, where they are now digging, was never covered with buildings, but was in the middle of a garden; there has been found a large quantity of rolls, about half a palm long, and round, which appeared like roots of wood, all black, and seemed to be only of one piece. One of them falling on the ground it broke in the middle, and many letters were observed, by which it was first known that the rolls were of papyrus. The number of these rolls, as I am told, were about 150, of different sizes. They were in wooden cases, which are so much burnt, as are all the things made of wood, that they cannot be recovered. The rolls, however, are hard, though each appears like one piece. Our king has caused infinite pains to be taken to unrol them and read them; but all attempts were in vain; only by slitting some of them some words were observed. At length Signor Assemanni, being come a second time to Naples, proposed to the king to send for one Father Antonio [Piaggi], a writer at the Vatican, as the only man in the world who could undertake this difficult affair. It is incredible to imagine what this man contrived and executed. He made a machine with which, by the means of certain threads, which, being gummed, stick to the back part of the papyrus, where there was no writing, he begins by degrees to pull, while, with a sort of engraver's instrument, he loosens one leaf from the other, which is the most difficult part of all; and then makes a sort of lining to the back of the papyrus, with exceeding thin leaves of onion [goldbeaters' skin] if I mistake not; and with some spirituous liquor, with which he wets the papyrus, by little and little he unfolds it. All this labour cannot be well comprehended without seeing. With patience superior to what man can imagine, this good father has unrolled a pretty large piece of papyrus, the worst preserved, by way of trial. It is found to be the work of a Greek writer, and is a small philosophic tract, in Plutarch's manner, on *Music*; blaming it as pernicious to society, and productive of softness and effeminacy. It does not discourse of the art of music. The beginning is wanting. The papyrus is written "across," in so many columns, every one of about twenty lines, and every line is about four inches long. Between column and column is a void space of "more than" an inch. The letters are distinguishable enough. Father Antonio, after he has loosened a piece, takes it off where there are no letters and places it between two [pieces of glass] for the better observation; and then, having an admirable talent in imitating characters, he copies it with all the lacunae, which are very numerous in the scorched papyri, and gives this copy to the Canon Mazzocchi, who tries to supply the loss and explain it. The letters are capital ones, and almost without any abbreviation. The worst is, the work takes up so much time, that a small quantity of writing requires five or six days to unrol, so that a whole year is already consumed about half this roll. The lacunae, for the most part, are of one or two words, that may be supplied by the context. As soon as this roll is finished, they will begin a Latin one. There are some so voluminous, and the papyrus so fine, that unrolled they would take up 100 palms space [or almost 100 feet]. The curiosity of these papyri is, that there is *no* little shaft of wood on which *they were* rolled."

It may here be remarked, that the practice of rolling books on an umbilicus of wood was by no means universal where papyrus was employed. The Egyptian manuscripts, for instance, so frequently found in the catacombs, are without any umbilicus, the end of the sheet being left blank, for the purpose of being doubled up into a sort of core, which remained unopened, and served instead of a roller. A wooden pen, without a slit, was found in some of the subsequent excavations, together with other materials for writing. In 1755 the name of Philodemus had been discovered at the end of the first manuscript, and another work of the same author, on *Rhetoric*, had been unrolled. Mazzocchi was translating these, and two persons were constantly employed upon other volumes.

Some interesting particulars respecting the history of these operations are also found in Barthélémy's *Voyage en Italie*, published at Paris in 1801. "It was a long time," says the author, "before any mode could be devised of unrolling them, and in this dilemma some of them were cut with a knife longitudinally, as we divide a cylinder in the direction of its axis. This mode of proceeding disclosed the writing to view, *but completely destroyed the work*. The different strata of the paper adhered so closely together, that in attempting to separate them they were reduced to "ashes" [or rather dust]; and all that could be obtained was a single column or page, of a manuscript, that consisted perhaps of a hundred."

"Under these circumstances, a patient and persevering monk suggested a mode of completely unrolling the paper. He made some attempts, which occupied a considerable portion of time, but in which by degrees he was successful. He goes on with his tedious labour, and in the same manner gradually and slowly succeeds. His plan is this. Having found the beginning of the manuscript, he fastens to the exterior edge some threads of silk, which he winds round so many pegs, inserted in a small frame. These pegs he turns with the utmost precaution, and the manuscript is imperceptibly unrolled. Lit-

tle is to be expected from the first few layers of the paper, which in general are either torn or decayed. Before any pages of a work can be obtained, the manuscript must be unrolled to a certain depth, that is, till the part appears which had suffered no other injury than that of being calcined. When a few columns have been thus unrolled, they are cut off, and pasted on linen. For unfolding one of these manuscripts, several months are requisite, and hitherto nothing has been obtained but the last 38 columns of a Greek work against music. Two other columns or pages are also shown, of two Greek manuscripts, that were cut to pieces before the method of unrolling them was discovered. Each appears to have been part of a philosophical dissertation."

In some letters from the Secretary of the French Embassy at Naples, subjoined by M. de St Croix, and dated 1785, 1786, and 1787, it is asserted that of about 1500 or 1800 manuscripts that had been discovered, 200 or more had been destroyed by a charlatan who undertook to restore them with the assistance of some chemical application: it is also stated as highly probable that many thousands of similar manuscripts may still exist in different parts of the ruins; a conjecture so much the more interesting, as the greater number of the rolls hitherto found "have been so crushed that it will never be possible to open them, and several have been injured by the *barbarous attempt* to separate the leaves with a knife."

The work of Philodemus was published in 1793, as the first volume of the *Herculanensium Voluminum quae supersunt*. f. Naples. The manuscript is faithfully delineated in copperplates, and the restored readings and translation are printed on the opposite page, followed by an elaborate commentary: the Academicians of Portici are the professed editors. The title at the end stands thus, the work being the fourth book only of the essay.

ΦΙΛΟΔΗΜΟΥ

ΠΕΡΙ ΜΟΥϹΙΚΗ

Δ

A passage in the last column will serve as another specimen.

ΡΑΙΝΟΝ ΤΑϹ ΤΟϹΑΥΤΑΤΟΙ
ΝΥΝΕΙΡΗΚΩϹ ΠΡΟϹΑΤΙΝ
ΕΓΚΕΧΕΙΡΗΚΑϹΙΔΙΑΤΕΙΝΑΙ
ΜΗΝΑΝΔΕΟΝΤΩϹΟ ΧΑΡΙΝ
ΜΕΝΠΙΘΑΝΟΤ ΤΟϹΑΥΤΩΝ

The subsequent volumes of the series are little known in this country. But a part of another manuscript was inserted in the *Herculanensia* of Sir W. Drummond and Mr R. Walpole (4to, Lond. 1810); together with a very favourable report of the progress of the operations, which had been continued under the patronage of his present Majesty, and at the expence of the British Government.

"Many obstacles," say the authors in their dedication to the Prince of Wales, "opposed themselves to the accomplishment of this noble design, which address and perseverance could alone remove. The difficulty of opening the rolls of papyrus, which had been reduced to a perfect carbo, can scarcely be conceived by those who have not witnessed the process. Much time and many hands were required in carrying it on; and the expence incurred was proportionate to the labour. When the manuscripts were unrolled, it was necessary that persons competent to the task should decipher and transcribe them; distribute the (capital) letters into the words to which they belonged; and supply those deficiencies in the text which but too frequently occurred. At the head of the directors of this difficult undertaking were Rosini, the editor of Philodemus; an English gentleman [the late Mr Hayter] sent out for the purpose by your Royal Highness; and, we believe, a Neapolitan priest, supposed to be deeply versant in ancient literature. It was not until large sums had been expended by your Royal Highness, and the success of the execution had justified the boldness of the plan, that pecuniary assistance was requested and obtained from Parliament. Attentive as the people of this country are, and ought to be, to the expenditure of the public money, they must glory in having contributed, with the heir-apparent to the British throne, in forwarding a work which does honour to the English name."

Again, in the preface, "The first papyrus which was opened contained a treatise upon *Music*, by Philodemus the Epicurean. It was in vain that Mazzocchi and Rosini wrote their learned comments on this dull performance: the sedative was too strong; and the curiosity, which had been so hastily awakened, was as quickly lulled to repose. A few men of letters, indeed, lamented that no further search was made for some happier subject on which learned industry might be employed; but the time, the difficulty, and the expence, which such an enterprise required, and the uncertainty of producing any thing valuable, had apparently discouraged and disgusted the academicians of Portici.

"Things were in this state, when his Royal Highness the Prince of Wales proposed to the Neapolitan government to defray the expences of unrolling, deciphering, and publishing the manuscripts. This offer was accepted by the court of Naples; and it was consequently judged necessary by his Royal Highness to select a proper person to superintend the undertaking. The reputation of Mr Hayter, as a classical scholar, justified his appointment to the place, which the munificence of the Prince, and his taste for literature, had created. This gentleman arrived at Naples in the beginning of the year 1802, and was nominated one of the directors for the developement of the manuscripts.

"During a period of several years, the workmen continued to open a great number of the papyri. Many, indeed, of these frail substances were destroyed, and had crumbled into dust, under the slightest touch of the operator.

"When the French invaded the kingdom of Naples, in the year 1806, Mr Hayter was compelled to retire to Sicily. It is certainly to be deeply regretted, that all the papyri were left behind. The wri-

ter of this preface only knows, with certainty, that when he arrived at Palermo in 1806, on his second mission to his Sicilian Majesty, he found that all the papyri had been left at Naples, and that the copies of those which had been unrolled were in the possession of the Sicilian government. How this happened, it would be now fruitless to inquire. The English minister made several applications to the court of Palermo to have the copies restored, but without success, until the month of August 1807. It was pretended, that, according to the original agreement, the manuscripts should be published in the place where his Sicilian Majesty resided; that several Neapolitans had assisted in correcting, supplying, and translating them; that his Sicilian Majesty had never resigned his right to the possession, either of the originals, or of the copies; and that, as a proof of this right being fully recognised, the copies had been deposited by Mr Hayter himself in the Royal Museum at Palermo. It was, however, finally agreed, that the manuscripts should be given up, *pro tempore*, to Mr Drummond, who immediately replaced them in the hands of Mr Hayter. In the space of about a year, during which period they remained in the possession of the latter, a fac simile of part of one of the copies was engraved, and some different forms of Greek characters, as found in these fragments, were printed under his direction.

"From some circumstances, which took place in the summer of 1808, and to which we have no pleasure in alluding, a new arrangement became indispensable. Mr Drummond proposed to the Sicilian government, that the copies should be sent to London, where they might be published with advantages which could not be obtained at Palermo. His proposal was acceded to, and they have been accordingly transmitted to England. The manner in which their publication will be conducted will, of course, depend upon the determination of his Royal Highness the Prince of Wales, in whose hands they have been deposited; but it may be presumed, that the Republic of Letters will not have to lament, that these interesting fragments are to be brought to light under the auspices of a Prince, who has always shown himself to be the protector of learning and the arts. We venture not to assert, but we believe, that the manuscripts will be submitted to the inspection of a select number of learned men, and will be edited under their care, and with their annotations and translations."

Mr Walpole informs us in a subsequent article, dated at Palermo, 1807, that the whole of the manuscripts that were then in Sir W. Drummond's house, amounting to more than EIGHTY, were Greek, with the exception of one fragment of a Latin poem, which is said to have been a description of the *Battle of Actium* and its consequences, and which has been conjectured by some critics to be the work of the Varius, well known by name as the friend of Horace. One of the *eighty* has appeared in the Herculanensia; but where are the *seventy-nine*? The whole of the manuscripts was reported to have been presented to the university of Oxford: has a new volcano, throwing out darkness and ashes, overwhelmed them on the banks of the Isis? Or were they, notwithstanding all the labour and expence of obtaining them, found too imperfect to deserve publication? It seems, indeed, not improbable, that the persons employed to unrol them in the first instance, who were paid in proportion to the number of pages they obtained, were too strongly tempted to sacrifice such parts of the manuscript as would have required the most labour, for the more profitable object of proceeding with a portion which would allow them to earn the most pay with the least loss of time, and that some irreparable injuries have been done to the manuscripts from these interested motives. Some pages, however, of the copies were certainly very little impaired, and these must at least deserve to be preserved from further accidents, by printing and publishing them in the simplest possible form.

It is well known, that at the time of the first arrangement between the two courts, respecting these operations, the King of Naples sent six of the rolls unopened, as a present to the Prince of Wales; nor were the antiquaries and philosophers of Great Britain inattentive to this latent treasure. Several experiments were made at Carlton House, in imitation of the processes which were said to have been successful in Italy; and at last, two of the manuscripts were entrusted to the care of an individual, who is supposed to have given an account of his own further attempts, in the fifth number of the *Quarterly Review*.

"At first," he informs us, "as it often happens in such cases, he appeared to be very confident of ultimate success; but difficulties afterwards occurred, and he did not continue his experiments long enough to overcome them, or even very materially to lessen them; his professional engagements interfered, much of his time had already been sacrificed, and the intelligence, that Sir W. Drummond had succeeded in obtaining possession of the whole collection of the works which had been unrolled, made his own attempts appear comparatively too insignificant to deserve immediate prosecution."

"One mode of treating the papyri occurred, however, to this gentleman, which appeared to him to promise a decided advantage to such as might hereafter proceed in the operation. This was the employment of the anatomical blowpipe, an instrument which he had many years before been in the habit of using for delicate purposes, in the place of a dissecting knife. The blowpipe served him . . for a knife and a forceps; for the gum, the goldbeater's skin, and the threads of the Italians. No instrument can be so soft in its pressure as the air, for holding a thin fragment by suction, without danger of injuring it; no edge nor point can be so sharp as to be capable of insinuating itself into all the crevices which the air freely enters. But the humidity of the breath he found to add much to the utility of the instrument. The slight degree of moisture, communicated to the under or inner surface of a fold, made it curl up and separate from the parts beneath, where the adhesion was not too strong; while dry air from a bladder was perfectly incapable of detaching it. But the process of separating every leaf in this manner was always tedious and laborious, where there was much adhesion, and sometimes altogether impracticable. Chemical agents of all kinds he tried without the

least advantage; and even maceration, for six months, in water, was unable to weaken the adhesion. It is remarkable that the characters were not effaced by this operation; so that the gum, which had fixed them on the paper, must have wholly lost its solubility, and the rest of its original properties.

"It has indeed been supposed by some travellers, that the manuscripts were, in reality, never charred, the ashes, thrown out by the volcano, having been probably incapable of communicating to them a sufficient degree of heat for producing this effect. In fact it is said that some of the spices, found in an embalmed body, retained a considerable portion of their aromatic smell. But there is no doubt whatever that the papyri are now complete charcoal, such as is formed by heat only. A small fragment of their substance burns readily, like common charcoal, with a creeping combustion, *without flame*, and with a slight vegetable smell; fresh papyrus burns with a bright flame; and almost all mineral coal, which may possibly have been formed from vegetable substances, without the operation of heat, flames abundantly. *Bovey coal*, for example, which retains much of the appearance of wood, exhibits a *considerable flame*. It is highly probable that many of the adhesions have been formed by the oily and smoky vapours distilled off from the hottest parts, and irregularly condensed in the colder; and, so far as this conjecture may be true, it would perhaps be advisable to try the effects of a *longer maceration* in alcohol and in *ether*, than has hitherto been employed. The "spear of Achilles" might also be applied with very reasonable hopes of success. A repetition of the exposure to heat, kept up more equably and more powerfully, might very probably expel the adhesive substances, without injuring the texture of the charcoal; proper care being taken to preclude completely the access both of air and of water, which might be done first by means of the air pump, and then by the insertion of a little potassium, together with the roll, in a vessel hermetically sealed. But the adhesions appear sometimes to be of a mere mechanical nature, being derived from the irregular folds, into which the manuscripts have been pressed, or from some roughness of the contiguous surfaces." P. 18. 20.

Mr Hayter thought it necessary to reply to some of the criticisms contained in this article, and published a pamphlet entitled *Observations upon a Review of the Herculanensia* (4to, London, 1810); strenuously maintaining that the quotation from the *comedy* of Timocles, already extant in Athenæus, ought to be a hexameter, and not an iambic; and seeming almost to believe that *Pluto*, and not *Plato*, is the author of the fanciful etymology of the name of Juno, though the passage quoted happens to be found in Plato's *Cratylus*. It is difficult to understand by what test the merits of such a scholar were appreciated, when he was appointed to superintend the operations at Portici.

The next era of our national exertions exhibits, however, a still more striking example of good nature and facility. Dr Sickler, of Hildburghausen, who had been in Italy as a private tutor, succeeded in convincing a Committee of the Royal Society of Gottingen, that he had unrolled a fragment of papyrus, of which he exhibited a specimen. There was no evidence that the particular manuscript, on which the experiment was said to have been performed, had presented any considerable difficulty; and it was well known that some of the pages had been read before with comparative ease. It happened, however, that the page in question bore the intrinsic marks of a gross fraud. At first sight, it read like perfectly good Greek, and it had all the genuine rust of antiquity about it; but, upon examination, it was found to contain a blunder which no Greek writer, nor any Greek librarian, could ever have committed; for the name of a serpent is made feminine, while in all ancient authors it is uniformly masculine; and the general air of authenticity was easily understood, when it was found that it was copied, with little variation, from detached passages of Diodorus Siculus, and principally from the fabulous account of the voyage of Jambulus to Ceylon and beyond it. In the meantime, a negotiation with Dr Sickler had been commenced; an account of it was published, with the specimen in question, under the title of *Herculaneum Rolls. Correspondence relative to a Proposition made by Dr Sickler*, 4to, London, 1817; the parties thought themselves too far engaged to retract; nor had they the patience to wait for the result of a preliminary experiment upon a portion of a roll, which had been weighed in London, and sent, carefully packed, to Hildburghausen, in order that the surface developed might be accurately compared with the weight: and Dr Sickler was brought to London, with his family, for the more effectual prosecution of his operations, which were so successful in a few months, as to ruin twelve chosen specimens, which had been sent over as a second present to the Prince of Wales; with the exception, however, of a few fragments, which were left sufficiently entire to be made the subject of some subsequent experiments of a chemical nature.

This mischievous farce was at last terminated by a *Report of the Committee appointed to superintend the Experiments of Dr Sickler*, ordered by the House of Commons to be printed, in March 1818; the Committee stating, in conclusion, that Dr Sickler had totally failed in his endeavours to satisfy them that his method was practicable; and annexing an account of the expenditure, of something more than L.1100, in the purchase of this total failure.

But one advantage, and that not an unimportant one, was derived from this investigation. Sir Humphry Davy had been appointed one of the superintending committee; and his studies having recently been directed to the different states of carbonic substances, in the course of his patriotic and benevolent researches into the means of preventing explosions in coal mines, he was the more naturally led to consider by what agents these apparently carbonised substances might be capable of modification. The whole detail of the process which he invented has never been made public, in order that it might not be abused by any unprincipled projector: but there is reason to think that it bears considerable analogy to the *maceration in ether*, which had been tried unsuccessfully, but still recommended as deserving further examination, by a less fortunate operator.

A very interesting report of Sir H. Davy on the the state of the manuscripts was published in the *Journal of the Royal Institution* for April 1819.

"My experiments soon convinced me," says Sir Humphry, "that the nature of these manuscripts had been generally misunderstood; that they had not, as is usually supposed, been carbonized by the operation of fire, and that they were in a state analogous to peat or *Bovey coal*, the leaves being generally cemented into one mass by a peculiar substance, which had formed during the fermentation and chemical change of the vegetable matter comprising them, in a long course of ages. The nature of this substance being known, the destruction of it became a subject of obvious chemical investigation; and I was fortunate enough to find means of accomplishing this without injuring the characters, or destroying the texture of the manuscripts.

"After the chemical operation, the leaves of most of the fragments perfectly separated from each other, and the Greek characters were in a high degree distinct; but two fragments were found in peculiar states; the leaves of one easily separated, but the characters were found wholly defaced on the exterior folds, and partially defaced on the interior. In the other, the characters were legible on such leaves as separated, but an earthy matter, or a species of tufa, prevented the separation in some of the parts; and both these circumstances were clearly the results of agencies to which the manuscripts had been exposed, during or after the volcanic eruption by which they had been covered.

"It appeared probable from these facts, that different manuscripts might be in other states, and that one process might not apply to all of them; but even a partial success was a step gained; and my results made me anxious to examine in detail the numerous specimens preserved in the museum at Naples. Having had the honour of showing some of my results to the Prince Regent, his Royal Highness was graciously pleased to express his desire that I should proceed in my undertaking; and I found, on my arrival at Naples, that a letter from his Royal Highness to the King, and a communication made from the Right Honourable the Secretary of State for Foreign Affairs to the Neapolitan Government, had prepared the way for my inquiries, and procured for me the necessary result of such patronage, every possible facility in the pursuit of my objects.

"An examination of the excavations that still remain open at Herculaneum immediately confirmed the opinion which I entertained, that the manuscripts had not been acted on by fire. These excavations are in a loose tufa, composed of volcanic ashes, sand, and fragments of lava, imperfectly cemented by ferruginous and calcareous matter. The theatre, and the buildings in the neighbourhood, are encased in this tufa, and, from the manner in which it is deposited in the galleries of the houses, there can be little doubt that it was the result of torrents laden with sand and volcanic matter, and descending at the same time with showers of ashes and stones, still more copious than those that covered Pompeii. The excavation in the house, in which the manuscripts were found, as I was informed by Monsign. Rosini, has been filled up; but a building, which is said by the guides to be this house, and which, as is evident from the engraved plan, must have been close to it, and part of the same chain of buildings, offered me the most decided proofs that the parts nearest the surface, and *a fortiori*, those more remote, had never been exposed to any considerable degree of heat. I found a small fragment of the ceiling of one of the rooms, containing lines of gold leaf and vermilion in an unaltered state; which could not have happened, if they had been acted upon by any temperature sufficient to convert vegetable matter into charcoal.

"The state of the manuscripts exactly coincides with this view; they were probably on shelves of wood, which were broken down when the roofs of the houses yielded to the weight of the superincumbent mass; hence many of them were crushed and folded in a moist state, and the leaves of some pressed together in a perpendicular direction, and all of them mixed in two confused heaps; in these heaps the exterior manuscripts, and the exterior part of the manuscripts, must have been acted on by water; and as the ancient ink was composed of finely divided charcoal suspended in a solution of glue or gum, wherever the water percolated continuously, the characters were more or less erased.

"Moisture, by its action upon vegetable matter, produces decomposition, which may be seen in peat bogs in all its different stages; when air and water act conjunctly on leaves or small vegetable fibres, they soon become brown, then black, and by long continued operation of air, even at common temperatures, the charcoal itself is destroyed, and nothing remains but the earths which entered into the construction of the vegetable substance. When vegetable matter is not exposed to moisture or air, its decay is much slower; but in the course of ages, its elements gradually react on each other, the volatile principles separate, and the carbonaceous matter remains.

"Of the manuscripts, the greater number (those which probably were least exposed to moisture or air, for till the tufa consolidated, air must have penetrated through it) are brown, and still contain some of their volatile substance, or extractive matter, which occasions the coherence of the leaves; others are almost entirely converted into charcoal, and in these, when their form is adapted to the purpose, the layers may be readily separated from each other by mechanical means. Of a few, particularly the superficial parts, and which probably were most exposed to air and water, little remains except the earthy basis; the charcoal of the characters, and some of that of the vegetable matter being destroyed, and they are in a condition approaching to that of the manuscripts found at Pompeii, where the air, constantly penetrating through the loose ashes, there being no barrier against it as in the consolidated tufa of Herculaneum, has entirely destroyed all the carbonaceous parts of the papyrus, and left nothing but earthy matter. Four or five specimens that I examined were heavy and dense, like the fragment to which I referred in the introduction to this report,

a considerable quantity of foreign earthy matter being found between the leaves, and amongst the pores of the carbonaceous substance of the manuscripts, evidently deposited during the operation of the cause which consolidated the tufa.

"The number of manuscripts, and of fragments originally brought to the museum, as I was informed by M. Ant. Scotti, amounted to 1696; of these, 88 have been unrolled, and found in a legible state; 319 more have been operated upon, and, more or less, unrolled, and found not to be legible; 24 have been presented to foreign potentates. Among the 1265 that remain, and which I have examined with attention, by far the greater number consists of small fragments, or of mutilated or crushed manuscripts, in which the folds are so irregular as to offer little hopes of separating them so as to form connected leaves; from 80 to 120 are in a state which presents a great probability of success, and of these the greater number are of the kind in which some volatile vegetable matter remains, and to which the chemical process, referred to in the beginning of this report, may be applied with the greatest hopes of useful results.

"The persons, charged with the business of unrolling the manuscripts in the museum, informed me, that many chemical experiments had been performed upon the manuscripts at different times, which assisted the separation of the leaves, but always destroyed the characters. To prove that this was not the case with my method, I made two experiments before them; one on a brown fragment of a Greek manuscript, and the other on a similar fragment of a Latin manuscript, in which the leaves were closely adherent; in both instances the separation of the layers was complete, and the characters appeared to the persons who examined them more perfect than before.

"It cannot be doubted, that the 407 papyri, which have been more or less unrolled, were selected as the best fitted for attempts, and were, probably, the most perfect; so that, amongst the 100 or 120, which remain in a fit state for trials, even allowing a superiority of method, it is not reasonable to expect that a much larger proportion will be legible. Of the 88 manuscripts containing characters, with the exception of a few fragments, in which some lines of Latin poetry have been found, the great body consists of works of Greek Philosophers or Sophists; nine are of Epicurus; thirty-two bear the name of Philodemus; three of Demetrius, and one of each of these authors, Colotes, Polystratus, Carneades, and Chrysippus; and the subjects of these works, and the works of which the names of the authors are unknown, are either *natural* or *moral philosophy, medicine, criticism,* and general observations on the *arts, life,* and *manners*."

The opinion of Sir Humphry Davy, and that of the anonymous operator, with respect to the state of the manuscripts, are so inconsistent with each other, that the decision between them seems almost reduced to the comparison of the credibility of opposite testimonies. According to the article in the *Quarterly Review,* "there is no doubt whatever that the papyri are now complete charcoal, such as is formed by heat only: a small fragment of their substance burns readily, like common charcoal, with a creeping combustion, without flame, and with a *slight vegetable* smell; . . Bovey coal exhibits a considerable flame." On the other hand, Sir Humphry's experiments have "convinced" him, that the manuscripts are "in a state analogous to peat, or Bovey coal: and he infers, from his examination of the surrounding objects, that they could not have been acted upon "by any temperature sufficient to convert vegetable matter into charcoal." Now it seems natural to prefer, on such an occasion, the authority which stands the highest with respect to the department of science in question, especially when one of the parties is unknown: but, in the present instance, some additional evidence may not be thought superfluous: and, in fact, a portion of one of the rolls, which had been examined both by Sir Humphry and by the earlier experimenter, has been very lately submitted to a new analysis, by a chemist well known for the minute accuracy of his investigations, and the solidity of his conclusions. He has exposed the carbonaceous matter to the process of destructive distillation, and he could obtain nothing whatever from it like asphaltum or any other product of mineral coal. It had scarcely enough of volatile matter to give any perceptible tinge of brown to the humidity absorbed by the substance, but enough to afford an animal smell, extremely like that of burnt bone, which he could only attribute to the glue or size of the ink, not completely decomposed by the same heat which had expelled all the volatile parts of vegetable origin: and upon exposing some glue, spread on paper, to the heat of boiling quicksilver, he obtained a partial carbonisation, which he conceived to be perfectly analogous to that of the manuscripts; the substance thus formed affording, when exposed to a stronger heat, very copious vapours of an empyreumatic oil, though the products of the vegetable matter were probably expelled by the heat first applied: and, on the other hand, the heat of boiling quicksilver did not produce the animal smell from the papyrus. Hence, he judged, that the precise temperature of the overwhelming mass might be ascertained with tolerable accuracy; and he was persuaded that nothing but a heat approaching to 600° of Fahrenheit could have reduced the roll which he examined to the state in which he found it. At any rate, when we consider that a heat a little above 220° is capable of blackening, when applied for a long continuance, the wood that surrounds the boiler of a steam engine, it seems very difficult to agree with Sir Humphry Davy in thinking that the manuscript could not have been subjected to "any heat capable of converting vegetable matter into charcoal:" unless by charcoal he understands pure carbon; and in this sense his observation will readily be admitted by all parties. It seems, indeed, to have been precisely with this conception of the state of the manuscripts, that it was suggested by the *Quarterly Reviewer* that some benefit might be expected from submitting the rolls to a heat more intense than that which they appeared to have undergone. The experiment, however, has been subsequently performed with considerable care;

but it failed completely of success. A fragment of a roll, consisting of several thicknesses, adhering together, was inclosed in a crucible, surrounded by charcoal powder, and kept for some time in a red heat: but no perceptible alteration took place in the state of the fragment, the adhesions were in no degree detached, nor was the legibility of the characters on the surface impaired.

After the failure of this experiment, in order to leave no mechanical means untried, a cutting machine was contrived, consisting of a very thin circular plate made into a fine saw, and put in rapid motion by wheel work; this apparatus was found perfectly capable of dividing the substance of the roll, without splintering it, as knives had been found to do; and it was hoped that, by cutting it across wherever there was a considerable fold, it would be possible to extricate many parts from each other, which were only retained in contact by this accidental complication of form; and that having the advantage of beginning from within, it would be easier to work down upon the successive surfaces bearing the letters, the writing being always found on the inside only; and no material difficulty was apprehended in reuniting the several parts, when they should once have been rendered legible. It was also recollected that the interior parts of the manuscript had in general been the least crushed and the least adherent; and it was hoped that a part at least of each manuscript might thus be rendered legible with ease, and at the same time without destroying the parts remaining unopened. But the interior parts of the roll, which had been thus divided, were found as adherent as the exterior, and the adhesions still remained every where invincible; so that all hopes of succeeding by mechanical means only were finally abandoned. The machine was afterwards sent to Naples, as it was thought likely to be of use in some of the operations that Sir Humphry Davy's process would require; but it is said not to have been found necessary for this purpose.

With regard to Sir Humphry's observation, that vegetable matter not exposed to moisture or air undergoes a much slower decay, but that in the course of ages "its elements gradually react on each other, the volatile principles separate, and the carbonaceous matter remains," it may be remarked, that the rolls of papyrus do not seem to undergo any change of this nature, in the course of twenty or thirty centuries; for the Egyptian volumes, which are often found inclosed within the bandages of mummies, are generally so free from decay, that the paper has retained its primitive whiteness, without much alteration, except sometimes a slight tinge of brown; and its texture is so little impaired, that it still bears ink well without running. When, however, a roll has been in any degree pervaded by moisture, the water is found to have dissolved the gum which unites the elementary leaves of the plant, and to have caused partial adhesions of the contiguous surfaces of the sheets to each other.

Whatever difference of opinion there may be respecting the reasoning on which Sir Humphry Davy appears to have grounded his processes, there can be little doubt that they have been actually employed with considerable advantage. Mr Burton was encouraged by the British government to undertake the manipulation of the chemical operations that were required; and Mr Elmsley was requested to prolong his stay in Italy, and to become the superintendent of the literary department. It is said, that, according to the latest accounts, Sir Humphry is well satisfied with his success, and that a great variety of manuscripts have been rendered more or less legible; but that their contents have proved of little more importance, than might have been expected from the nature of the specimens before examined.

There can be no doubt that if Mr Elmsley attempts the restoration of any of the mutilated manuscripts, his labours will be free from such errors as have disgraced some of the former restorers of the Greek text; for, in fact, even the work of Philodemus on *Music*, which is commonly supposed to have been so well edited, exhibits some singular instances of a want of familiarity with the idiom of the language, and of a critical knowledge of its rules. In the 38th and last column, which was cursorily examined, for the purpose of selecting a specimen of the characters only, a passage occurs which is thus read and translated by the "Academicians of Portici." Τοσαυτα τοινυν ειρηκως, προς ἁ τινες εγκεχειρηκασι, δια τ᾽ ειναι μην αν δεοντως, ὁτι χαριν μεν πιθανοτητος αυτων ουδε πολλοστημοριον ωφειλον εκτεινειν. *Tot igitur tantaque disserui adversus ea quæ aliqui tractarunt*, propterea quia opportunum fortasse erat. *Namque profecto propter ipsorum suadelam ne minima quidem parte debebam me extendere.* It is scarcely necessary to point out to any Greek scholar, that the true reading must be διατειναίμην ἂν δεόντως. "Having said thus much, *I may probably have been sufficiently diffuse* in replying to the arguments of some persons; but "that," in proportion to the plausibility of these arguments, I ought not to have extended my discussion beyond a very small part of its actual magnitude . ."

Such mistakes, however, can do but little injury to the mutilated authors, provided that the original be preserved at the same time in its unaltered state. But that original, in its authentic though imperfect form, is the only object of comparative value; and to delay its publication, for the sake of restorations of any kind, seems to be but a refined species of selfishness. "When we reflect," says the *Quarterly Reviewer*, "on the shortness of human life, and on our own grey hairs, we tremble to think how little chance there is of our being benefited by any great proportion of the EIGHTY manuscripts still unpublished." Ten years, alas, have now elapsed since these reflections were printed, and not a line of the manuscripts in question has yet made its way to that public, which had so equitable a claim to a full communication of their contents.

It must not, however, be denied, that to the great majority of readers it would be far more agreeable and convenient to have the works not only restored but translated, if it could be done with tolerable accuracy, and without any very great loss of time. And even where a *probable* restoration is beyond

Her culaneum || Herefordshire.

our reach, it might be of some advantage to substitute a *possible* one. Thus, the specimen which has been copied from the *Philosophical Transactions* for 1752, might suggest the three hexameters,

ALTER.IN.ALTERIUS.DULCI.AMPLEXU. MORITURUS.
NON.EQUIDEM.CURIS.CRUDELIA.FATA.MOVERI.
POSSE.REOR.NEC.ME.VITAE.SPES.VANA.FEFELLIT.

Lines which are not indeed very harmonious or poetical, but which *might* have stood in the same work with

CONSILIIS.NOX.APTA.DUCUM.LUX.APTIOR.ARMIS,

and with Cleopatra's

TRAHITURQUE.LIBIDINE.MORTIS,

which are almost the only specimens that we possess of the poem attributed to Varius. If several independent attempts of this kind were made by different critics, the presumption in favour of those restorations, which were found to be common to all, would be raised from a mere possibility to a strong probability; but whether the same expence of labour and talents, directed into some other channel, might not create original works of still greater value, is a question not easy to be decided.

It is, however, of the less consequence to decide it, as the British operations on the manuscripts have been somewhat abruptly terminated : and the whole of this article must be considered as historical only. The failure of the experiments is attributed to the mutilated state of the rolls which were subjected to them, the best having been already opened; so that little has been obtained from the attempt, except a knowledge of the subjects of some of the manuscripts examined, which were almost all in Greek, and all in prose. The whole investigation has been conducted with all possible caution and economy; and if nothing has been added to our literary treasures, at least nothing has been taken away from our scientific reputation. (F. O.)

HEREFORDSHIRE, an inland English county, bounded on the north by Shropshire, east by Worcestershire, south by Gloucestershire and Monmouthshire, and west by the Welsh counties of Brecknock and Radnor. Its greatest length is thirty-eight, and its greatest breadth thirty-five miles. It is nearly of a circular form; but the dividing lines are broken by many indentations. Its circumference is 120 miles, and its square area 1221 miles, or 781,440 statute acres.

Boundaries and Extent.

Divisions and Population.

It is divided into eleven hundreds, containing one city, seven towns, and 221 parishes. By the census of 1811, it appeared to have 19,296 houses, inhabited by 20,081 families. The inhabitants were 94,073, of whom 46,404 were males, and 47,669 females. The marriages, in the preceding year, were 663; the male baptisms 1353; the female 1303; making together 2656. The male deaths were 853, the female 832, making 1685. The number of families subsisting from agriculture were 12,399; those on trade and manufactures were 5044, and the others were 2438.

Face of the Country.

The face of the country is very beautiful, when viewed from the western descent of the Malvern hills. The whole country is rather thickly inclosed with high hedges; the divisions of the fields are generally small; and the abundance, both of forest and fruit trees, with which its surface is covered, gives it the appearance of an extensive wood. The roads are all narrow and bad, and even the turnpike ones are scarcely an exception.

Herefordshire.

Soil and Climate.

In the eastern side of the county, a part of the Malvern hills is rather barren, as are the Hatterel or Black Mountains, which divide it from Wales on the west. With the exception of these two portions, the whole of the land is highly fertile, and the fields are clothed with perpetual verdure. The soil is generally a mixture of marl and clay, but contains calcareous earth in various proportions in different parts. Towards the western part, the soil is tenacious, and retentive of water; the eastern side is principally a stiff clay, in many places of a red colour. In the south, some of the soil is a light sandy loam. The subsoil is almost universally limestone; in some parts a species of marble, beautifully variegated with red and white veins, and capable of receiving a high polish. Where the soil does not rest on limestone, as near the city of Hereford, it is sometimes a siliceous gravel, and occasionally fuller's earth and yellow ochres are found. The climate is rather more inclined to rain than the more eastern parts of England, and at times is much subject to damp fogs, which moisten the earth, and may be one cause of its great verdure.

Cultivation of Corn.

The cultivation of grain is generally in a state behind most of the English counties, and the crops bear no proportion to the goodness of the soil. Wheat is generally sowed on a clover ley, with a dressing of lime, and then yields, on an average, twenty bushels to the acre. After this wheat is harvested, a winter and spring ploughing are followed by peas, which do not average more than fourteen bushels to the acre. The peas are followed by wheat again, when the produce is not usually more than fourteen bushels. In the succeeding spring it is sowed with barley and clover, neither of which crops yield a good increase. Oats are only sowed partially in the place of barley. Turnips are carelessly cultivated, and artificial grasses sowed to a very limited extent, though somewhat increased of late years. On the borders of some of the rivers there are most valuable meadows of natural grass, which are the most productive of any lands in the county.

Hops.

One cause of the neglect manifested in the cultivation of corn may be the attention paid to the growth of hops and fruit. The cultivation of hops is considerable, and increasing on the borders of Worcestershire, and much more of the manure is applied to them than to the corn. The soils selected for hop gardens are those where a dry loam predominates, with but a small proportion of clay, and old pastures are deemed more fit for them than the land that has been recently under the plough. The time of planting them is usually the month of April. In July the gardens are hoed carefully, and the same operation is repeated five or six weeks after; and in September the earth is formed into hillocks around the roots of the young plants. The hops are picked from the plants in October, are then gently dried in

a kiln, and packed for sale. The average produce of an acre of garden is about five hundred weight of hops. Each acre requires 1000 poles, around which the plants entwine themselves. The cost of poles, of manure, and of labour, makes the cultivation highly expensive, and in some years far to exceed the amount of the produce, but in others the growers gain very large profits. The whole is a very speculative pursuit.

The rearing of fruit-trees, to the growth of which, the soil and climate seem admirably adapted, engrosses the greatest share of the attention and skill of the Herefordshire cultivators. Although almost every soil and situation in the county is favourable to the growth of apples and pears, yet those spots are preferred which are exposed to the south-east and sheltered to the westward; as it is found that the winds from that quarter are ungenial to the fruit-trees. Orchards, though planted in Kent as early as the reign of Henry the Eighth, did not extend to Herefordshire till they were introduced by Lord Scudamore and some other gentlemen in the reign of Charles the First, when the discovery of their adaptation to the soil being ascertained, they quickly spread over the whole county. It is a fact, that many varieties of apples and pears, which a few years ago were the most highly esteemed, have entirely disappeared; but new varieties have by care and attention been produced, which equal in value, if not in fame, the celebrated *Redstreak* and *Sline* apple, and the *Squash* pear, the value of whose cider and perry was thirty years ago most highly prized. Some of the proprietors of orchards, who are most attentive to the selection of the fruit, and most skilful in the management of the juice when expressed, have produced such exquisitely flavoured cider and perry as to obtain for them a preference over any wines made from the grape. The prices at which the best of these liquors are sold by the growers, far exceeds those that are obtained for the best wines of any vineyards either in France or Germany. They are sometimes sold as high as L. 20 the hogshead direct from the press. Some of the orchards are from thirty to forty acres in extent, and the trees being at considerable distance from each other, the intervals are kept in tillage. The produce of the orchards is very fluctuating, though less so in Herefordshire than in Somerset, Devon, or Gloucester; yet the growers seldom expect more than one year in three to be fully productive. In a good year an acre of orchard will produce from 18 to 24 hogsheads of cider or perry. The quantity of apples or pears required to make a hogshead varies from 24 to 30 bushels. The greater part of the best descriptions of both liquors is purchased by merchants from Bristol, who find bottles, and export it to the East and West Indies, and to America.

Herefordshire has been long celebrated for one of the best races of cows. They are of the middle horned kind, have a large and athletic frame, and, from the silky nature of their coats, have an unusually sleek appearance. The most prevailing colour is a reddish brown, and their faces are white and bald. The heifers fat quickly at an early age, and the calves are highly esteemed. The rearing of oxen for the plough is a common pursuit, and the greater part of the animal labour of the county is performed by them. After being worked five or six years they are usually sold to graziers from Buckinghamshire, and fattened in the vale of Aylesbury for the consumption of the metropolis, where their flesh is highly prized.

Sheep.

The fame of the Herefordshire sheep equals that of its cows. They are best known by the name of the Rylands, a district in the southern part of the county, in which the superior varieties of them are fed. They are small, white faced, and without horns. In symmetry of shape, and in the exquisite flavour of the meat, they surpass most other kinds; and, in addition, their wool is by far the finest produced from any of the native English races. The quantity of wool from them does not average more than two pounds each, but it is usually sold for three times the price of coarse wool. Many experiments have been made to improve this breed by crossing them with the Merinos; but it has been found that the flesh has deteriorated as much as the wool has improved by the mixture. The practice of keeping the sheep in houses in cold weather is general, and perhaps the wool may be in some degree indebted to that management for a portion of its fineness of fibre.

Trade and Manufactures.

The excellence of the wool has not induced many manufactures, for most of it is sold to the clothiers of Gloucestershire and Somersetshire. Attempts have been made to establish manufacturers of woollen goods in the city of Hereford, but they proved abortive. At Kington some few woollens are made, and likewise at Leominster, but to no great extent. The river Wye is navigable to Hereford, but either floods or droughts so often suspend the navigation, that the trade carried on by it is very inconsiderable. Two canals have been begun, one from Ledbury to Gloucester, and another from Leominster to Stourport, but neither are yet finished; nor does the trade of the county give any prospect of success to these undertakings when they shall be completed.

Rivers.

The principal river, the Wye, is celebrated for its picturesque beauties, especially in the vicinity of Ross, and till it enters Monmouthshire. The other streams, the Lugg, receiving the waters of the Arrow and the Frome, the Munnow receiving those of the Dore, and the Leddon, are but inconsiderable, though they tend to fertilize the lands through which they flow.

Antiquities.

Few counties are more rich in antiquities than Herefordshire, especially in the remains of those feudal castles, which were probably erected when it was the frontier towards the hostile Welsh. The most remarkable of these are Goodrich Castle, Dore Abbey, Wigmore Abbey, Vineyard Camp, and Bransil Castle.

The towns in Herefordshire, and their population, are,

	Houses.	Inhabitants.
Hereford, -	663	7306
Leominster, -	764	3238
Ledbury, -	625	3136
Ross, - -	556	2261

Hereford-shire || Hertford College.

	Houses.	Inhabitants.
Kington, -	341	1617
Pembridge, -	288	1135
Bromyard, -	244	1101

Two members are returned to Parliament from the county, two from the city of Hereford and two each from Leominster and Weobley. The towns in Herefordshire are generally worse built than in any other English county, and more nearly approach to those of their adjoining Welsh neighbours. In the villages the buildings are still worse. The construction of most of the farm houses and barns is rude and slight; they are usually built of stone, only cemented with mud or clay, about two feet high; and upon these imperfect walls the superstructure is raised, composed of timber frame work, with laths intertwined and plastered with mud or clay. They are usually covered with thick flag stones, which increase the weight, and soon reduce them to a most ruinous state.

See Duncomb's *Herefordshire;* Marshall's *Rural Economy;* Lodge's *Sketches;* Clark's *General View;* and Brayley and Britton's *Beauties of England*, Vol. VI. (W.W.)

HERTFORD COLLEGE. The extension of our empire in India, which now contains sixty millions of people, has made it necessary to provide a succession of able men to fill the various departments, both of the civil and military government. Whilst at first the Royal Academy at Woolwich, and recently the Military College established near Croydon, furnished instruction to those destined to hold commissions in the artillery and engineer corps, the education of those who were to fill the most important civil offices had not been provided for. During the brilliant administration of the Marquis Wellesley, that intelligent observer saw and lamented this want of previous instruction, and founded at Calcutta a collegiate institution, to provide the means of acquiring a knowledge of the languages, the laws, and the local usages of our Indian empire. The Directors of the Company disapproved in part of the plans of the Governor-general; but they at the same time felt the necessity of giving some knowledge to those whom they had nominated as *Writers;* for so those are still called, in compliance with early custom, who are designed to fill the highest offices, both judicial and executive, under the Indian government.

With this view the College of Hertford was founded; the design of the institution being to train up a race of youths, who should in succession fill the various and important offices of the civil government and administration. "To dispense justice to millions of people of various languages, manners, usages, and religions; to administer a vast and complicated system of revenue, through districts equal in extent to some of the most considerable kingdoms in Europe; to maintain civil order in one of the most populous and litigious regions in the world; these," says Marquis Wellesley, "are now the duties of the larger portion of the civil servants of the Company. The *senior merchants,* composing the courts of circuit and appeal under the presidency of Bengal, exercise in each of these courts a jurisdiction of greater local extent, applicable to a larger population, and occupied in the determination of causes infinitely more intricate and numerous, than that of any regularly constituted courts of justice in Europe. The senior or junior merchants employed in the several magistracies and courts, the writers or factors filling the stations of registers, and assistants to the several courts and magistrates, exercise, in different degrees, functions of a nature purely judicial, or intimately connected with the administration of the police, and with the maintenance of the peace and good order of their respective districts." The Marquis points out, in the same strong manner, the arduous duties of the several departments which the Europeans are required to perform in India, and sums up by saying, "that the civil servants of the East India Company can no longer be considered as the agents of a *commercial concern;* they are, in fact, the ministers and officers of a *powerful* sovereign; they must be viewed in that capacity with a reference not to their nominal, but to their real occupations. They are required to discharge the functions of magistrates, judges, ambassadors, and governors of provinces, in all the complicated and extensive relations of those sacred trusts and exalted stations, and under peculiar circumstances, which greatly enhance the solemnity of every public obligation, and the difficulty of every public charge. Their duties are those of statesmen in every other part of the world; with no other characteristic differences than the obstacles opposed by an unfavourable climate, a foreign language, the peculiar usages and laws of India, and the manners of its inhabitants."

The final result of the various discussions of the Court of Directors has at last been to maintain the College of Calcutta, for the sole purpose of affording instruction in the different languages and dialects of India, and to devote a college in England to those branches of knowledge which can be cultivated under more favourable circumstances in Europe than in India.

The system of education adopted holds a due medium betwixt the strictness of our public schools and the laxity of the English universities. Upon being appointed, which is unfortunately too much an affair of patronage on the part of the directors, each youth must, previous to his admission, produce a testimonial from his schoolmaster, and pass an examination in Greek and Latin, and arithmetic, before the principal professors. This previous examination at once prevents persons from offering themselves, who have not received the usual school education of the higher classes of society; and those who offer themselves, and are found deficient, are remanded till another period of admission. The lectures of the different professors in the college are given in a manner to make previous preparation necessary, and to encourage most effectually habits of industry and application. In their substance, they embrace the important subjects of Classical Literature, the Oriental Languages, the elements of Mathematics and Natural Philosophy, the Laws of England, General History, and Political Economy.

Hertford College.

At the commencement of the institution, it was feared by some persons that this variety would too much distract the attention of the students at the age of sixteen or seventeen, and prevent them from making a satisfactory progress in any department; but instances of distinguished success have proved that this variety has not only been useful to them in rendering a methodical arrangement of their hours of study more necessary, but has decidedly contributed to enlarge, invigorate, and mature their understandings.

On all the important subjects above enumerated, examinations take place twice in the year. These examinations, which continue twelve days, are conducted upon the plan of the great public and collegiate examinations in the universities, particularly of Cambridge, with such improvements as experience has suggested. The questions given are framed with a view to ascertain the degree of progress and actual proficiency in each particular department on the subjects studied during the preceding term; and the answers, in all cases that will admit of it, are given in writing, in the presence of the professors, and without the possibility of a reference to books. After the examination in any particular department is over, the professor in that department reviews, at his leisure, all the papers that he has received, and places, as nearly as he can, each individual in the numerical order of his relative merit, and in certain divisions implying his degree of positive merit. These arrangements are all subject to the control of the whole collegiate body. They require considerable time and attention, and are executed with scrupulous care and strict impartiality.

Besides the classifications above mentioned, prize-medals, books, and honorary distinctions, are awarded to those who are the heads of classes, or as high as second, third, fourth, or fifth, in two, three, four, or five departments.

These means of exciting emulation and industry have been attended with great success. Those who have come to college tolerably good scholars, have often, during their stay of two years, made such advances in the classical department, as would have done them great credit if they had devoted to it the main part of their time; whilst the contemporary honours which they have obtained in other departments have sufficiently proved that their attention was not confined to one study; and many who had come from public and private schools at sixteen, with such low classical attainments, as appeared to indicate a want either of capacity or application, have shown, by their subsequent progress even in the classical department, and still more by their exertions in others, that a new field and new stimulants had wrought a most beneficial change in their feelings and habits, and had awakened energies of which they were before scarcely conscious.

It has been found at some periods extremely difficult to maintain the requisite discipline, owing chiefly to the tenacity of the directors concerning their patronage. Those who have nominated a youth to the college, and to the subsequent place of a *Writer* in India, were unwilling to risk the loss of so valuable an appointment, by placing the power of expulsion for misconduct in the hands of the professors. This seems to have been the real cause of the disorders which have occurred, and which have come before the public with most exaggerated circumstances. The whole proceedings of the college are regularly laid before a committee of the directors; and that body certainly has not confided sufficient powers to the heads of the college to enable them to enforce due discipline. Their authority has, indeed, been recently somewhat extended, but without greater power, the college can scarcely be expected to become so beneficial to our Indian Empire, as the high talents of the professors, in the list of whom are the illustrious names of Sir James Mackintosh and Mr Malthus, give the public a right to expect.

Hertford College || Hertfordshire.

The course of study continues two years, and commences at such an age, that the students may be ready to proceed to India by the time they are eighteen or nineteen years old; and having begun the study of the Oriental languages, they are prepared to prosecute them in Calcutta, so as to proceed to their official appointments by the time they have attained the age of twenty or twenty-one.

Each pupil, of whom there are eighty, pays L. 100 *per annum* to the college; this lessens the expence of the establishment, and reduces it to less than L. 10,000 a year; whereas the expence of the college at Calcutta, founded by Lord Wellesley, amounted in one year to upwards of L. 70,000, and in several subsequent years to more than L. 40,000. (W. W.)

HERTFORDSHIRE, an inland English county of great riches, derived principally from its vicinity to the metropolis of the British Empire. It is bounded by Essex on the east, by Bedfordshire and Cambridgeshire on the north, by Buckinghamshire on the west, and by Middlesex on the south. Its extreme length is thirty-eight miles, and its greatest breadth twenty-eight miles. Its area is about six hundred and twenty square miles. It is divided into eight hundreds, and contained 17 towns, 134 parishes, and 20,781 houses, at the time of the last survey. — Boundaries and Extent.

In 1811, the inhabitants were 111,654, of whom 55,023 were males, and 56,631 females. The whole number of families was 22,744, of which 11,998 were employed in agriculture, 7192 in trade and manufactures, and 3554 in different unclassed pursuits. In the year preceding the census, the baptisms of males were 1665, of females 1574; the marriages were 614; the burials of males were 996, of females 1016. From the great number of persons dissenting from the established church, the number of baptisms is necessarily deficient, and that of burials also, but in a less degree. — Population.

It is generally a level district, with gentle undulations, no part rising to the height of mountains, though Kingsworth Hill, the most elevated spot, is nine hundred feet above the level of the sea. Though beautifully diversified with ornamented woods, there are no extensive tracts of forest land. The intermixture of pasture and arable fields with the great number of gentlemen's seats, the pleasing — Face of the Country.

Hertfordshire.

rivulets and the shady hedges, give it a peculiar character of beauty. Notwithstanding the deficiency of forests, the abundance of trees, especially oaks of ancient growth, which the hedge rows and parks display, give a richness to the scenery which is surpassed by that of no county in England.

Rivers and Canals.

The rivers of Hertfordshire are, *First,* The Lea, which rises in Bedfordshire, enters this county at Hide-mill, passes by Ware, and to Hertford, where it becomes navigable. Near Hoddesdon, it forms a junction with the Stort, and at length falls into the Thames a little below London. The Stort is navigable to Bishops Stortford, at the extremity of the county. In its course it receives the waters of the smaller streams of the Rib, the Quin, the Beane, the Maran, and the Kime. *Second,* The Colne, which rises on the borders of Middlesex, passes through the western part of the county, and falls into the Thames at Brentford. It receives in its course the Gade, the Bulborne, and the Ver, or Meuse. This river, in some parts of its course, forms a part of the *Grand Junction Canal* for several miles, and, afterwards separating from it, continues its course in a parallel direction, till it reaches its mouth. *Third,* The Ivel, a river composed of the inferior streams of the Oughton, the Iliz, and the Pirral. These, when united, pass into Bedfordshire, and, at length, reach the German Ocean. The river, made by artificial means to supply the metropolis with fresh water, called the New River, has its sources in various springs in the vicinity of Ware, and is rendered more copious by borrowing water from the river Lea, whose course is parallel to it for many miles. The New River enters Middlesex before it reaches the reservoir, from whence by pipes it is distributed to the different houses of the metropolis. That extraordinary work, the *Grand Junction Canal,* passes through a great part of this county in its progress from its union with the other canals to its termination in London.

Soil.

In almost every part of this county the subsoil is calcareous, consisting of two species, one a pure chalk, the other of a softer kind, mixed with portions of whitish clay, and provincially called marine. The superior soil does not contain any great varieties of species. It is generally a clayey loam, in some parts highly tenacious, and retentive of moisture; on the higher grounds it is frequently mixed with many surface stones. There are some sandy loams intermixed with gravel, and others with clay. Some of the parts on the side of Essex are very wet, and require expensive draining, as well as copious quantities of manure, to render them fruitful. In the neighbourhood of North-Mims and Hatfield the soil is very sterile, mixed with many springs of a sulphureous or ferruginous nature, and only rendered productive by expensive improvements. Near Baldock, Hitchen, and King's Walden, the upper soil is of a chalky nature, occasionally mingled with other earths, but generally rather poor.

Agriculture.

The greater part of Hertfordshire is a corn-bearing country. The proportion of meadow land, or good pasture, is very small, if those parts are excepted which are contiguous to the numerous gentlemen's seats with which the county abounds. There are indeed some very rich pastures on the banks of the river Stort, which extend from Hertford to Hockeril, on the borders of the river Lea, and near Rickmansworth, where they are watered by the Colne. The whole of the meadow land is susceptible of great improvement by irrigation; but the vicinity to the metropolis makes the streams of water so valuable to turn mills, that little of their contents can be afforded to assist agriculture. The rotation of crops on the arable lands is very various, as may be supposed where the soil is so different. The most common course is turnips, barley, clover, wheat, and oats. In the districts where the soil is of a more tenacious consistence, fallows are very generally used for a whole year, and followed by barley, clover, wheat, and peas or beans. The average quantity of wheat sown is two bushels and a half to the acre; of barley, from three and half to four bushels; and of oats, from four to five bushels. The average produce is, wheat, from twenty-three to twenty-five bushels, barley, thirty-two, and oats from thirty-eight to forty.

The drill husbandry is very partially introduced; and, from the nature of the soil, does not appear very likely to make any very rapid or extensive progress. It is found beneficial for pulse crops, but its superiority for barley, wheat, and oats, does not appear to be generally recognised. The ploughs now commonly used are small, and have almost superseded the use of the great Hertfordshire ploughs, which required four strong horses to use them with effect. In a great part of the country oxen are used in the plough, and frequently in the waggons,—in the latter case they are shod with light iron shoes.

The principal cause of the productiveness of this county arises from its vicinity to the metropolis, and the facility with which abundance of the substances adapted to improve the soil can be furnished, by means of the water carriage, which is extensive. On the land, below the surface, chalk is found everywhere; this, laid on at the rate of a hundred cart loads to the acre, improves the heavy lands in a wonderful degree; but the manures brought as back carriage by the barges from London are diffused and applied in a very liberal manner. Soot is spread at the rate of thirty or forty bushels to the acre; ashes from fifty to one hundred bushels to the acre; and ground bones from four to five chaldrons, on the same extent of land. For the pastures, burnt bones are deemed preferable, but for arable land they are merely boiled and crushed. Oil-cake, peat-ashes, hair, woollen rags, and other substances, are much employed. In addition to these, the use of the sheep-fold, and the application of farm-yard dung, are as universal as in any part of the island.

Fruits.

In the south-west part of the county there are many orchards of apples and of cherries; the former the most considerable and the most profitable to the growers, from being less expensive to gather, and bearing carriage to London better than cherries. The cherry trees are in full bearing after being planted ten years, and on an average yield about six hundred pounds of cherries annually. They are usually inferior to those of Kent, and sell for much less in the markets. Each cherry tree is usually allowed nine

square perches of ground. The size of the orchards, whether for apples or cherries, is usually four or five acres.

tle. As this is a corn country, less attention is paid to the breeds of cattle than in some others. The cows are either of the Welsh, Devon, Suffolk, or Herefordshire races; the Suffolk breed is generally preferred. The sheep are mostly breeding ewes of the South Down or Wiltshire kind, the former are deemed the most profitable. Of late, a species of sheep, from crosses between those of Leicestershire and those of the Cotswold Hills, have been extensively and beneficially propagated. Oil-cake is very extensively used for feeding sheep. The horses commonly employed for agricultural purposes are of the Suffolk kind; for their sustenance, as well as for that of sheep and cows, great tracts of land are cultivated with both kinds of tares and with clover.

nded Property. The landed property in Hertfordshire is so much divided that there are few great proprietors, and none so large as in many other counties; few rentals of individuals exceed L. 3000 *per annum*. A large part of the county is *copyhold tenure*, with fines in some instances fixed, and in some, such as the lords of the manors and the copyholders can agree upon. The farming buildings are generally neat, convenient, and substantial.

nufactures and ade. Though principally an agricultural county, yet Hertfordshire has several manufactures which give employment to the poor. In the western and northern part of the county the making of thread lace gives occupation to the females. On the side towards Bedfordshire the plating of straw to make hats employs considerable numbers both of women and children. There are silk mills at St Albans, and mills for spinning cotton at Rickmansworth. Some of the finest writing paper is made at Twowaters by mills on the Colne and the Bulborne. Great quantities of malt are made at Ware, Hertford, Bishops Stortford, and other parts of the country; and the makers of it, as well as the numerous millers, have the advantage of water conveyance to the metropolis. As little wood is used for firing, the barges that convey malt and flour to London bring back coals, or, when they are not wanted, are loaded with manure. These articles form the principal trade of the county.

ool. A portion of the children of Christ Hospital, in London, are sent to Hertford at an early period of their entrance on that foundation. The building appropriated for this purpose forms three sides of a triangle at the east end of the town, and contains appartments for 500 children, their master, and attendants.

ntiquities. This county abounds with many antiquities. The most striking is the Abbey of St Albans, a most beautiful Gothic pile, said to have been founded in honour of the first British martyr, in the year 303, on the site of the ancient Verulam. The vicinity of this abbey was the theatre of many bloody battles during the wars of the rival houses of York and Lancaster. Lord Bacon was buried, not in the abbey, but in St Michael's church, near it, where his monument is still in good preservation. The ruins of Sopwell Nunnery, near St Albans; the remains of Gorhambury Abbey; the Roman Camp at Ravensborough; the Cross at Waltham; the Church at Kings Langley, and the Castles of Anstey, of Bennington, of Hertford, and Bishops Stortford, all invite and gratify the attention of the antiquarian.

Hertfordshire returns six members to the House of Commons; two for the county, and two for each of the boroughs of Hertford and St Albans.

The towns, containing more than 1000 inhabitants in the year 1811, were the following:

Towns.	Houses.	Inhabitants.
Hertford,	598	3900
St Albans,	621	3658
Hitchen,	789	3608
Ware,	684	3369
Hemal Hemsted,	648	3240
Rickmansworth,	581	3230
Hatfield,	508	2677
Bishops Stortford,	486	2630
Watford,	519	2603
Berkhamsted,	396	1963
Standon,	353	1882
Tring,	351	1847
Baldoch,	259	1438
Royston,	283	1309
Stevenage,	306	1302
Hoddesdon,	232	1249
Waltham Cross,	212	1152

See Brayley's *Hertfordshire*, and Young's *Survey*. (W. W.)

HEYNE (CHRISTIAN GOTTLOB), an illustrious classical scholar and archæologist, was born on the 25th September 1729, in a suburb of the city of Chemnitz, in Saxony, where his father, having been compelled by some religious persecutions to abandon his native country of Silesia, had settled; supporting his family, in great poverty, by exercising the trade of a weaver. It was only by the liberality of his godfathers that Heyne was enabled to obtain his primary instruction in the elementary school of Chemnitz, and afterwards to prosecute his classical studies in the *Gymnasium* of that city. In 1745, he entered the University of Leipsic. There he was so scantily supported by those on whose assistance he relied, that he was frequently in want even of the common necessaries of life, and was sometimes indebted for food to the generosity of a maid servant in the house where he lodged. In this situation, without even the hope of future distinction, he continued to struggle against every difficulty and disappointment in the acquisition of knowledge. For six months he is said to have allowed only two nights in the week to sleep, and was at the same time forced to endure the reproaches which his godfather thought himself entitled to inflict on him for negligence in the prosecution of his studies. His distress had almost amounted to despair, when he procured the situation of preceptor in the family of a French merchant resident in Leipsic. He was thus enabled to continue his studies, though with much interruption; the emoluments of his appointment being sufficient to support him in what was at least comparative comfort. Under Ernesti, he was initiated into the criticism of the classical authors; from the prelections of the celebrated

Bach, he acquired a competent knowledge of the Roman jurisprudence, and through the instructions of Christius, who lectured on Archæology, and with whom he was intimately acquainted, his attention was strongly directed to the works of ancient art. Having finished his studies at the university, he was exposed for many years to all the accumulated distresses of poverty and neglect. The first situation he was able to procure was that of copyist in the library of Count de Bruhl, with a salary of only an hundred dollars, which he obtained in the year 1753. From the necessity of adding something to this scanty pittance, he was forced to employ himself in the drudgery of translation; and besides some French novels, he translated into German the Greek romance of Chariton. He published his first edition of Tibullus in 1755, and in 1756 his Epictetus. In 1756, his emoluments of copyist were doubled, and the education of Prince Maurice de Bruhl was entrusted to him, but without any additional salary. The invasion of Saxony by the Prussians deprived him of his appointment, and even destroyed the library on which it depended. The period of the seven years war was that in which he was chiefly exposed to the storms of fortune; and his marriage with Theresa Weisse, a young woman of distinguished genius, but equally poor with himself, increased his misery. Having been obliged to retire into Lusatia, he lived for some years as steward in the family of the Baron de Leoben. He was enabled, however, to return to Dresden in 1762, where he was entrusted, by Lippert, with the care of writing the Latin text of the third volume of his *Dactyliotheca*.

At length, in the commencement of the year 1763, his merit met with its reward, and a new and illustrious career was opened to him. On the death of John Matthew Gesner, in 1761, it became necessary for the curators of the University of Göttingen to look around for a successor capable of sustaining the reputation which the institution had acquired by the learning and talents of that distinguished scholar. The appointment was offered to Ernesti, who, while he declined leaving the University of Leipsic, proposed Ruhnkenius of Leyden or Saxius of Utrecht for the situation. Ruhnken likewise refused the appointment, but having been strongly impressed by the taste and learning displayed by the editor of Tibullus and Epictetus, he advised Munckhausen, the Hanoverian minister and principal curator of the University of Göttingen, to bestow the professorship on Heyne, whose merit, though known to few, he ventured to promise would do honour to the choice. The minister had the good sense to acquiesce in the recommendation of this great scholar, and Heyne, after some delay, became *Professor of Eloquence* in Göttingen. Though his appointments were, at first, few, and his emoluments inconsiderable, these were gradually augmented in proportion as his usefulness was approved, and as his growing celebrity rendered it an object with the other governments of Germany to secure for their literary institutions the services of so distinguished a scholar. He refused the most advantageous and honourable overtures from Cassel, Berlin, and Dresden. In his different capacities of Professor, Principal Librarian, Member of the Royal Society, and chief Editor of the Literary Gazette, and still more by his publications, he mainly contributed to raise the University of Göttingen to the distinguished rank it holds among the Academies of Europe. After a long and useful career, graced with all the distinctions which are in Germany conferred on literary eminence, he died, full of years and honour, on the 14th July 1814.

In Greek literature, he has given us editions of Homer's *Iliad*, Pindar, Diodorus Siculus, Apollodorus, and Epictetus; and, in Latin, editions of Virgil and Tibullus, all illustrated with copious commentaries. His *Opuscula Academica*, in 5 volumes, contain a series of 116 academical dissertations, of which the most valuable are those respecting the antiquities of Etruscan art and history, and the researches regarding the colonies of Greece. He has left us also a great number of papers on almost every subject of erudition, more especially on ancient mythology, among the *Commentationes Societatis Regiæ Gottingensis*. His *Antiquarische Aufsätze*, in 2 volumes, comprise a valuable collection of essays on different subjects, connected with the history of ancient art. In the earlier part of his life, he translated, or rather wrote anew, a great part of the *Universal History*.

After this notice of the chief events of his life, and of his literary productions, it may be proper to say somewhat in regard to the distinctive merit which has raised Heyne to so eminent a place among the promoters of classical literature. And here it is chiefly as an interpreter of the ancient poets, and as an original investigator of the ancient mythology, that he must rest his claims to the celebrity he has acquired. As a critic of the works of art, his desert is great, but he has no pretensions to original or peculiar discoveries.

The example of the great philologists of Holland, and the more immediate influence of Ernesti and Gesner* on the taste and pursuits of their countrymen, had, before the middle of the last century, awakened in Germany a new zeal for the study of the ancient authors, and had advanced the criticism of classical literature to a rapid and vigorous maturity. The great writers of antiquity ought not, however, to be read with a regard limited merely to their language; they more especially deserve a close and enthusiastic study for the admirable means which they afford of improving the understanding, and of cultivating the taste. From the year 1760, about which period the Germans had begun to devote themselves with an enthusiasm, as zealous as it was tardy, to the cultivation of their native language and literature, several intelligent philologers displayed a more refined and philosophic method in their treatment of the different branches of classical learning; who, without neglecting either the grammatical investigation of the language, or the critical constitution of the text, no longer regarded a Greek or Roman writer as a subject for the mere grammarian and critic; but considering the study of the ancients, as a school for thought, for feeling, and

* See the Article Ernesti in this *Supplement*.

for taste, initiated us into the great mystery of reading every thing in the same spirit in which it had originally been written. They demonstrated, both by doctrine and example, in what manner it was necessary for us to enter into the thoughts of the writer, to pitch ourselves in unison with his peculiar tone of conception and expression, whether erroneous or correct; and in every instance accurately to investigate the circumstances by which the mind of the poet or philosopher was affected, the motives by which he was animated, and the influences which co-operated in giving the intensity and character to his feelings. It was shown how generally the conception of the reader was merely a veil thrown over the thought of the original. It was no longer allowed to combine modern with ancient ideas, to convert the derivative with the original thought, or to translate it by a new and factitious signification. At the head of this school stands Heyne, both as its founder and principal ornament; and, however some of his disciples may have exposed themselves to ridicule in their application of the principles on which this system of interpretation rests; yet it cannot be denied, that nothing has contributed so decisively to maintain and promote the study of classical literature, as the combination which Heyne has effected of philosophy with erudition, both in his commentaries on the ancient authors, and in those works in which he has illustrated various points of antiquity, or discussed the habit of thinking and spirit of the ancient world.

The poverty of Germany in manuscripts has compelled her scholars to rest satisfied in general with the critical apparatus which the philosophers of other nations have collected. What they necessarily wanted in the originality of subsidiary stores, they have, however, endeavoured to supply, by a sound and rational employment of those already compiled; and the praise of useful diligence cannot certainly, with justice, be denied to their labours in this department. Originality, however, was possible in the higher criticism, which does not rest on the collection of readings or the authority of manuscripts, and in the mode of the illustration applied to the ancient writers; in these respects, the later philologers of Germany have earned a glory peculiar to themselves, and which must be remembered as long as learning and ingenuity are respected. How cogently have they reasoned on the authenticity or spuriousness of particular writings, and how skilfully have they applied the test to the interpolations of later times; to what new conclusions are we now brought in regard to Orpheus, Homer, Anacreon, Longinus, &c. by the critical investigations of Schneider, Wolf, Fischer, Hermann, Weiske, and others; how differently has the controversy in regard to the authenticity of certain orations of Cicero been recently concluded by Wolf, compared with the result of Markland's and Gesner's investigations! In this department, Heyne does not, however, hold the same preeminence, which he has attained as an enlightened and popular interpreter; for though his discussions in the higher criticism are both numerous and valuable, he is as much surpassed in boldness and originality by Wolf, as he is inferior to Hermann in the minuteness and ingenuity of his reasoning.

There is, however, another department in which the labours of Heyne are more original, and in which he merits all the honour to which a discoverer is entitled. Until the middle of the eighteenth century, mythology was nothing else than the nomenclature of divinities, a collection of the manifold and discordant legends of their several relations, actions, and destinies, and the delineation of their forms from the works of the poets and artists, illustrated, perhaps, by a mystical and allegorical commentary. About this period some profounder thinkers began to regard the mythical traditions in a higher view, as sources of human history; but from too confined an acquaintance with the circumstances and condition of the ancient world, they took too high a standard for their explanations, and through a mystical and allegorical interpretation, thinking they had discovered under the veil of mythological narration, ideas of the deepest wisdom, they confidently framed thereon hypotheses for the history of mankind, for the arts, for philosophy and the other sciences, which threatened altogether to extinguish the glimmering light that was still afforded us for the periods of remote antiquity.

Heyne opened a less ambitious but more certain path. Following the observations which travellers had collected in regard to new and uncivilized nations, he applied these to the condition of the Greeks, who, as history informs us, from a rude and sensual barbarism, gradually advanced to a state of civilization and intellectual refinement. He thus arrived at the simple conclusion, that the mythical tales of antiquity contain the first attempts at reasoning, the most ancient history, philosophy, and theology embodied in a poor, unformed, and consequently figurative language; and, therefore, that mythology is a system comprising, partly the original form of representation through objects of sense peculiar to a rude age, expressed in fables, ceremonies, and monuments, transplanted into later times; partly a kind of poetical apparatus derived and formed from this original mythology, and intended only by its authors for the purposes of poetical effect. He hence justly concluded that it is impossible to attain any real insight into the nature of mythical narration, unless the *mythi* of the most ancient poets are carefully distinguished from the abusive applications made of them in the poetry of after times, and unless mythology be kept separate from the philosophy conversant about mythology. In conformity with these fundamental rules, Heyne has illustrated Apollodorus, and in the same spirit he has conducted those researches into the nature and tendency of the different mythi of Greece, which he has published in the *Transactions of the Royal Society of Göttingen.* His views have been almost universally admitted to be correct in principle, and his applications to have been conducted with the profoundest learning, and almost unequalled ingenuity. A great number of followers have pursued the path he opened, and his theory has now attained the form and stability of a system through the labours of his disciples. Among these the names of

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Martin Hermann (not the philologer), of Voss, and of Manso, are especially to be distinguished. The theologians of Germany have likewise applied the same theory to the interpretation of the Sacred Books; and the researches of Eichhorn, Bauer, Ilgen, Hartmann, Vater, De Wette, and of a host of other philosophical divines, into the pretended biblical mythi, have been pursued with a learning and acuteness equalled only by the impious audacity of their conclusions.

HIMALEH, or HIMALAYA (literally the *Seat of Snow*), sometimes HIMACHAL (*Snowy Mountains*), are the names given to a vast range of lofty mountains which separates India from the two Thibets, and forms the highest part of that extended chain, which was known to the ancient writers of Europe by the names of *Imaus* or *Emodus*; being, in all probability, a corruption of the Sanscrit name; as "*Imaus*," says Pliny, "in the language of the natives, signifies *snowy*."

Extent of the Chain.

If we consider the Himalaya as extending from the defile near Cashmere through which the Setlij or Sutledge flows, to that through which the Bramapootra passes, the length will be, from north-west to south-east, nearly 1000 British miles; the western extremity being about the latitude 32°, and longitude 77°; the eastern about the latitude 24°, and longitude 95°. Through the whole of this extent their snow-capt summits present a succession of peaks of great but unequal elevation, some of which, in the fine pure atmosphere of Hindostan, are visible at an almost incredible distance. "The southernmost ridge of the Bootan mountains," says Major Rennell, "rises near a mile and a half perpendicular above the plains of Bengal, in a horizontal distance of only fifteen miles; and, from the summit, the astonished traveller looks back on the plains, as on an extensive ocean beneath him." Beyond is a chain of peaks still higher, which, he adds, "are visible from the plains of Bengal, at the distance of 150 miles, and are commonly covered with snow." From these expressions, and from his conclusion of their being "in point of elevation equal to any of the mountains of the old hemisphere," it is quite clear, that this celebrated geographer had no adequate idea of their real height.

Inferior Cluster of Mountains.

On the northern termination of the plains of Hindostan is a narrow belt of a thickly wooded, swampy country, called Terrana, between which, and the base of the great Himalaya chain, lies a broad tract of a rugged mountainous region, from 60 to 100 miles in width, full of fertile and well peopled valleys, and once divided into a number of petty states, which are now mostly absorbed by the British or the Chinese empires; the latter at least laying claim to some of the hilly countries to the south of the Himalaya, as tributary states, to which our recent conquests have brought us into immediate contact. Beginning at the westward, the principal of these states were Sirinagur, Almora, Kemaoon, Gorkah, Nepaul, and Bootan; all of these are parts of the mountainous belt, and their towns and fortresses occupy the summits of hills rising to the height of 4000 to 6000 feet; and many of the shoulders or abutments which connect these hills with the lofty range of Himalaya are from 8000 to 14,000 feet high. The great extent of these mountain masses produces a greater degree of cold in winter than would probably be found in the same degree of latitude in Europe at an equal elevation; and, as will presently appear, a greater degree of heat also. In the middle of winter the snow covers the summits of those inferior hills, and falls sometimes even in the interjacent valleys; but the climate, in every part of this mountainous region, is delightfully fine, and almost all the species of European vegetables are found in a native state, and growing in the greatest luxuriance. In fact, since we have had free access to the base of the Himalaya range, it has been discovered, that the general character of the vegetation corresponds very nearly with that of the middle and southern parts of Europe, and that a very large portion of the trees and shrubs of the latter are indigenous in the former; such as pines of various species, oaks, chesnuts, horse-chesnuts, walnuts, birch, the hazel, the raspberry, gooseberry, bilberry, barberry, and strawberries. Many of the flowering shrubs, and the humbler plants, as the polyanthus, anemone, and ranunculus, the common and lemon thyme, mint, sweet basil, and a great variety of other aromatic plants, clothe the sides of the hills, and shed their fragrant odours around: Moorcroft mentions the furze (Ulex Europea), which was supposed not to be met with out of Europe. These hills may be considered as the roots and branches of the great stem, all of them connected more or less remotely with it, and, appearing at a distance, when seen from the plains of Hindostan, as a succession of inferior ranges; but, on entering the country, "the whole," says Mr Frazer, "becomes a confused and chaotic assemblage of most rugged mountains, huddled into masses and peaks, and running into ridges which defy arrangement." *

Himaleh. Vegetable Products.

Opinions as to the Sources of the Ganges.

The highest peaks of the Himalaya mountains had long been noticed before it was known or even conjectured what their absolute height might be above the level of the sea. All the information respecting them that could be obtained was derived from Hindoo pilgrims, who annually flocked to pay their devotions at the shrine of some deity, presiding over the various wild and awful features of these elevated regions. To a people gifted, like the Hindoos, with strong imaginative faculties, the snow-capt summits of the Himalaya mountains, and the numerous torrents issuing from their bosom, which, when united into one grand stream, carried fertility over their extensive plains, could not fail to become so many varied objects of their veneration. From the accounts of these people, the main branch of the Ganges was represented to issue from a chasm or cavern in the side of the mountains, to which, from its supposed resemblance to the mouth of an animal sacred in the ritual of their faith, was given the

* *Journal of a Tour through part of the Snowy Range of the Himala Mountains.* 4to. Lond. 1820.

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name of the *Cow's Mouth*. This cavern was supposed to perforate quite through the great chain of mountains, and the source of the Ganges to be in a lake on the other side, considerably to the eastward of the Cow's Mouth. This lake was named Manonsarowar, and was held sacred; and under the impression of the relation of pilgrims being correct, the source and the passage of the Ganges were laid down in the most improved maps of Hindostan.

Expedition to the source of the Ganges.

The authority, however, on which this hypothesis rested not being deemed satisfactory, it was determined by the Bengal government that an expedition should be undertaken to ascertain how the fact stood; and Captains Raper and Hearsay, accompanied by Lieutenant Webb, assistant-surveyor, set out in the spring of the year 1808, in order to clear up this point; and from their observations, and those of more recent travellers, it has now been ascertained, that the main sources of the Ganges are all on the southern side of the great Himalaya chain; and that, reckoning from the westward, they consist of, 1. The Gumna (whose two great branches are the Girree and the Touse); 2. The Bhagarathe, whose source is near the celebrated spot called Gangoutri, where the Cow's Mouth is supposed to be situated; and, 3. The Alakananda, with its numerous tributary streams, the last of which rivers is now acknowledged as the main branch of the Ganges.

The object of Captains Raper and Hearsay was to penetrate as far as possible to the sources of the two great branches, the Bhagarathe and the Alakananda. With great difficulty and fatigue they approached near enough to Gangoutri, to enable them to conclude, from the contraction of the stream, and the stupendous height and unbroken sides of the Himalaya mountains, that "there can be no doubt but the source of that branch is situated *in* the snowy range;" and that "any other hypothesis can scarcely be reconciled to hydrostatical principles." Not quite satisfied, however, with this conclusion, they dispatched one of those fanatics of India, known by the name of Fakir, who deem a pilgrimage to Gangoutri to have the effect of redeeming the person performing it from all the troubles of this life, and of ensuring him a happy passage through all the stages of transmigration, which he is destined to undergo in another, to push his inquiries farther into the mountains. This man reported, on his return, that a few miles beyond Gangoutri, the river was lost under vast beds of snow, and that a rock in the midst of the rushing stream resembled the body and head of a cow; and here the valley was terminated by the steep and wall-sided mountain.

The party next set out in order to trace the other great stream of the Ganges, the Alakananda, and succeeded in reaching a spot four or five miles beyond the temple of Bhadrinath, where the stream was narrowed to eighteen or twenty feet, and where "the north faces of the mountains were completely covered with snow from the summit to the base." A little way beyond this place was a cascade named Barsiè d'Hara, where the Alakananda (or, as sometimes called, the Vishnuganga) was entirely concealed under immense heaps of snow, beyond which no traveller has been known to pass. Yet this place was estimated to be still distant about twenty miles from the southern front of the Himalaya chain. In these lofty regions, beyond Bhadrinath, stands the populous town of Manah, consisting of two hundred houses; the inhabitants of a different race from the generality of the mountaineers; and from their broad faces, small eyes, and olive-coloured complexions, evidently of a Tartar origin. Seven hundred villages are said to be attached to the Temple of Bhadrinath, whose sanctity may be estimated by the fact of no less than 40,000 pilgrims, chiefly fakirs, having visited it that year.

Not less holy in the estimation of the Hindoos, though less frequented from the difficulty of access, is the source of the main stream of the Alakananda, named the Caligunga, near which is situated the Temple of Kedar-nath, at an elevation of 12,000 feet nearly above the level of the sea. This place was not visited by Messrs Raper and Hearsay, but its height has recently been ascertained barometrically by Captain Webb.

Though this expedition threw considerable light on the nature of the country between the plains of Hindostan and the southern base of the Himalaya Mountains, and succeeded in tracing two of the most considerable branches of the Ganges nearly to their sources, still the great chain of the Himalaya itself had not yet been approached, and the altitude of its various peaks above the level of the sea remained undecided. The account, however, given by Captain Raper (*Asiatic Researches*, Vol. XII.) is full of interesting and important details.

Expedition of Mr Moorcroft across the Himalaya Chain.

The task of penetrating this vast chain was left to the exertions of a more daring traveller. Mr Moorcroft, accompanied by Captain Hearsay, the same who had been on the former expedition, and by a Hindoo Pundit, of the name of Harkh Deo, set out with the hope of finding a passage across these mountains into the regions of Tartary, in order to purchase horses and the shawl-goat, and, at the same time, to collect such geographical information respecting these unknown regions as might fall within their reach. With the latter view, the learned pundit was engaged for the express purpose of *striding* over these mountainous regions, for the whole route, in regular paces of four feet each; a task which, it seems, he performed with exemplary patience and perseverance across rocks and rivers and the most rugged precipices, without failing or faultering, except on one single occasion, where a piece of rock had slipped out of a narrow ledge on the very verge of a tremendous declivity, and left a gap just wide enough to show an abyss below, of a depth sufficient to appal the stoutest heart.

Beginning their operations at the point where the Dauli river falls into the Alakananda, they followed up the former to the very base of the Himalaya, and, after eighteen days of excessive fatigue, reached a gorge in the mountains, named the Nitee Ghati, or pass of Nitee. At some distance below it was a small village of the same name, whose great height was inferred by the hill, terminating the valley on which it stood, being tipped with snow on the 5th June, and also by a quick breathing with which

Mr Moorcroft was seized, and which obliged him to stop every four or five steps; he complained also of a sense of fulness in the head, accompanied by giddiness. In ascending the ghaut, the difficulty of breathing increased, with great oppression about the heart; and, when on the point of falling asleep, a sense of suffocation was felt, and sighing became frequent and distressing. The same symptoms of oppression and debility were experienced by M. Saussure on the Alps, which he ascribed rather to the presence of carbonic acid gas, than to the tenuity of the atmosphere. We conceive, however, that the great height alone is sufficient to account for these symptoms.

At Nitee the travellers were informed that the passage of the mountains was never attempted before *Sancrant*, or the entrance of the sun into Cancer; they waited, therefore, till the 24th June. For the last twenty days, the thermometer at sunrise was generally about 46°; at noon 72°, and from that to 80°, the nights clear and serene; the birch trees and rose bushes were just then bursting into leaf, the furze coming into blossom, and the grain appearing above the ground.

The Plateau or Table-land of Tartary.

The length of the Nitee pass is about two miles; it leads to an elevated plain to which there is little or no descent, called by the natives Undes or Ondes, which signifies "the country of wood." The name of Thibet was not known to them, and Captain Webb thinks it may have been derived from *Teiba*, which signifies, in the Ghorka language, "high-peaked mountains." The mountains crossing this plain, or rising in detached masses out of its surface, were covered with snow. The first, and indeed the only continued ridge seen by Moorcroft, was at the distance of about forty miles from the Himalaya, and nearly parallel to it, closing, however, gradually upon it to the eastward; but, at the distance of above eighty miles, they united not far from the two lakes of *Rawan-hrad* and *Manonsarowar*, which were separated from each other by a slip of land about four or five miles in width. The ridge thus uniting with the Himalaya is named Caillas, which is rather a generic term for any high mountain, than peculiar to a single one, and is with the Hindoos what Olympus was with the Greeks.

The intermediate plain consists of a rugged stony surface, bristled in some places with rude shapeless rocks, and, in others, scooped out into broad and deep ravines, presenting, on every side, an extended dreary waste, without a tree or shrub to enliven the prospect, the only vegetation being confined to some low furze bushes, a woolly plant like everlasting, tufts of silky grass, and a species of moss, exhibiting a sickly green, among patches of snow, and splashes of snow water. The only enlivening objects that appeared to Mr Moorcroft and his party were "two very beautiful poplar trees, in which were many goldfinches." These were on the banks of a considerable stream, flowing to the westward, down the middle of the plain, in the bed of which was a species of tamarisk, then in blossom, and reaching to the height of eight feet.

Source and direction of the Sutlege.

This river was then conjectured, and has since been ascertained, to be the Sutlij, or Satudra. It rises in the lake Rawan-hrad, to the eastward of any of the sources of the Ganges, and having collected in its western course the various streams from the northern face of the Himalaya, and the southern face of the Caillas, finds a passage through the former chain, near Mount Kantel, on the eastern side of Cashmere; and, on entering the plain of Hindostan, becomes the easternmost of the Penjab, or Five Rivers, the boundary of our Indian possessions to the westward; and, in its course to the southward, joins the Indus. This source and direction of the Setlij can now be no longer doubted, as its course, which was ascertained to lie through the great range of mountains by Mr Baillie Frazer, has since been traced back through the ravine of the Himalaya, and for a considerable distance to the eastward. On this elevated plain is situated the town of Deba.

Supposed Source of the Indus.

Mr Moorcroft and his party having passed the first table-land, crossed the Caillas range, on the other side of which the rugged plain extended beyond the reach of sight. The numerous streams from the northern face of Caillas, uniting in the vale of Ghertope, form a river of considerable magnitude, which, from information, pursues a north-westerly course for some hundred miles, passes by Latak, and then crossing the Hindoo-coosh (which may be considered as a prolongation of the Himalaya) to the westward of Cashmere, assumes the name of Indus or Scinde; of which great river it may be considered as one of the main branches, the other coming from the northward out of the mountains called the Moos-tag.

Supposed Source of the Brampootra.

Mr Moorcroft did not ascertain what river or rivers flowed *out* of the lake Manansorawar, and seems to think that it has no outlet. This is very improbable, as its water was fresh, and there seems to be little doubt but the Sanpoo, or the main branch of the Bramapootra, issues from its eastern extremity. In that case, this lake may be considered as about the highest part of the general level of the great plateau of Tartary.

Geography of the Mountainous Region decided.

Thus, by the exertions of recent travellers, the geography of the great mountainous buttress which supports the elevated regions of Thibet and Tartary is now pretty well decided; but all is still conjecture, as far as regards an extensive range of country to the northward, the north-westward, and north-eastward of the Caillas range of mountains.

Absolute Height of the Himalaya not known.

Neither the ancients, to whom the Himalaya mountains were well known, nor the Hindoos, to whom they have always been the cherished objects of veneration, nor our countrymen, who, from the plains of Bengal, had so often gazed at their snow-capped summits from a distance of 150 miles, ventured to form a conjecture even of their absolute height above the level of those plains. Mr Colebrooke, in his Note to Captain Raper's *Narrative*, observes, that, "without supposing the Himalaya to exceed the Andes, there is still room to argue, that an extensive range of mountains, which rears high above the line of perpetual snow, in an almost tropical latitude, an uninterrupted chain of lofty peaks, is neither surpassed nor rivalled by any other chain of mountains *but* the Cordilleras of the Andes." Shortly after this, however, he thinks the observations of Lieutenant Webb "authorize an universal

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declaration of the opinion, that the Himalaya is the loftiest range of Alpine mountains which has yet been noticed, its most elevated peaks *greatly exceeding* the highest of the Andes." On this point, a writer in the *Quarterly Review* joins issue, and contends that, from the unmeasured and unknown distance at which the very small angles were taken, and the uncertainty of the quantity of terrestrial refraction to be allowed in the calculation, no certain conclusion could be arrived at, and that the results must necessarily be inaccurate, and may be erroneous to the extent of several thousand feet.

sults of ious Observations ascertain Height Peaks.

The highest part of the Himalaya is about the centre of the chain, or between the source of the Bhagarattee to the valley of Nepal. From an observation taken by Colonel Crawford (when at Cathmandu, in Nepal, in 1802) of very small angles at the extremities of a short measured base, it is concluded that one peak, called Dhaibun, rose to an elevation of 20,140 feet above the spot where the observation was made; which being itself 4500 feet above the level of the sea, would make the height of this peak 24,640 feet. By similar observations, the height of another peak was proved to be 22,319 feet; of another, 24,525; another, 22,952 feet; and of a fifth, 23,162 feet above the level of the sea.

But the peak which was found to possess the most extraordinary elevation was that called *Dhawala-giri*, the *White Mountain*. By a mean of three observations, taken from the following computed distances, and seen under their respective angles, namely,

At station A, distance	$89\frac{35}{100}$ miles.	Ang. 2° 48′
——— B, ———	$102\frac{85}{100}$ ———	——— 2° 19′
——— C, ———	$136\frac{35}{100}$ ———	——— 1° 22′

and, by allowing for refraction, the height of this mountain is calculated at 27,677 feet above the plains of Gorak'hpur; which plains being 400 feet above the mouth of the Ganges, it follows, that the whole height of Dhawala-giri must be taken at more than 28,000 feet above the level of the sea. By a subsequent calculation, however, the height of this peak was reduced to 26,862 feet. Of this and six other peaks, the following are the results of Mr Colebrook's calculations, made from the observations of Lieutenant Webb:

	Feet.
Dhawala-giri ("on the lowest computation"), - - -	26,862
Jamunawatari, or Jamautri, -	25,500
A mountain supposed to be Dhaibun,	24,740
A nameless mountain, -	22,768
Another nameless mountain, -	24,625
Another, near the last, - -	23,262
A third, in its vicinity, -	23,052

These heights are probably exaggerated; it appears, indeed, that subsequent observations, made by Lieutenant Webb, with an excellent instrument, from the extremities of a well determined and sufficient base, have decided them to be so. They make, for instance, the height of the first "nameless mountain," in the above table, only 21,000 feet above the plains of Rohilkhund, or 21,500 above the level of the sea, being a deduction from Mr Colebrook's calculation, for the same mountain, of 1268 feet.

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The following table exhibits the results of Mr Webb's corrected observations, of no less than twenty-seven different peaks of the Himalaya range, as taken in the progress of his survey of Kamaon; but, for the accuracy of which he candidly admits it would be impossible to vouch, under all the circumstances by which the observations were taken. They are, however, in all probability, not far from the truth:

No. of Peak.	Altitude.	No. of Peak.	Altitude.
1 -	22,345	15 -	22,419
2 -	22,058	16 -	17,994
3 -	22,840	17 -	19,153
4 -	21,611	18 -	21,439
5 -	19,106	19 -	22,635
6 -	22,498	20 -	20,407
7 -	22,578	21 -	19,099
8 -	23,164	22 -	19,497
9 -	21,311	23 -	22,727
10 -	15,733	24 -	22,238
11 -	20,681	25 -	22,277
12 -	23,263	26 -	21,045
13 -	22,313	27 -	20,923
14 -	25,669		

Barometrical Observations.

Since these trigonometrical deductions were made, Lieutenant (now Captain) Webb has had the good fortune to succeed in making several barometrical observations in the Nitee Pass, through which Moorcroft had reached the plateau of Tartary. In his way thither, he reached nearly the base of those lofty peaks of the Himalaya which tower above the temple of Kedar-nath, whose altitudes are among those previously determined by triangulation, at a great distance, and seen under very small angles. He had, however, at this place, the advantage of observing one of these peaks under an angle of 26° 15′ 15″; and this, he says, gave him a result that agreed as well as could be expected with the position and altitude he had formerly assigned to it. The temple itself, by the mean of five barometers, was found to be 11,897 feet above the level of Calcutta, or about 12,000 above that of the sea, yet no snow lay near it the beginning of July.

Captain Webb next proceeded to Josimuth, near the commencement of the defile leading to the Nitee pass, where he met with one of the Civil servants of the East India Company proceeding on a mission to the frontier, with a view of opening a commercial intercourse with the Tartars. These subjects of China, however, declined all connection with us, and pushed forward picquets of cavalry to guard the pass. This untoward circumstance did not deter Captain Webb from proceeding. On approaching the pass, he experienced the same difficulty of breathing which occurred to Moorcroft; and from the influence of which, he says, neither horses nor yaks are exempt. The natives call it *Bis-Kee-huiva*, or the poisonous atmosphere; and conceive it to be owing to the effluvia of certain flowers.

He found in the Pass a troop of Tartar cavalry, who, with some inhabitants of Deba, received him kindly, and consented to let him remain until an

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answer should be received from Ghertope respecting his farther progress, which, at the end of fifteen days, was a negative, or, which amounted to the same thing, a reference to the Viceroy of Lassa. He had been permitted, however, to proceed to the crest or highest ridge of the Nitee Ghaut (which is at or near its farthest extremity), and to make his observations, which are exceedingly interesting and important. On the 21st August at three P. M., by the mean of four barometers, the mercury stood at 16,27 inches, the thermometer at 47°: on the same day and hour, and the two preceding and following days, the state of the barometer and thermometer at Dumdum, about 50 feet above the sea, by a journal of the weather kept by Colonel Hardwicke, was as follows:

Aug. 19,	barometer 29,46 inches.	Ther. 88°
20,	29,46	84
21,	29,48	85
22,	29,48	84
23,	29,65	81
Mean,	29,51	84.4

From which the Nitee Ghaut above Dumdum must be 16,764 feet, and above the sea 16,814 feet. Yet, at this extraordinary elevation, not a vestige of snow appeared in the Ghaut, nor on the shoulder of the ridge on the left of the pass, which rose to the height of 300 feet above it,—from whence it would appear, that the lower point of congelation, on the northern or Tartarian side of the Himalaya, is *not less than seventeen thousand feet!*

Elevation of the Table Land of Tartary.

From the crest of the Ghaut Captain Webb was able to perceive the line of the Sutlij winding through the plain to the westward, and to take the angle of depression, from which, and Moorcroft's distance (generally found to be correct), he determined the elevation of this lowest part of the table-land of Thibet to be 14,924 feet. The angle of depression was 1°, 28′, 10″, and the distance 15½ British miles. Notwithstanding this enormous elevation of 15,000 feet, the banks of the Sutledge afford the finest pastures for myriads of quadrupeds; and crops of a species of barley called Ooa, from which the natives make their bread, are annually produced. Nay more; on the cheeks of the Nitee Pass plants were found that ripened their seed at the height of 17,000 feet. These singular anomalies, so utterly at variance with the theories of Humboldt, Leslie, Kirwan, and all European writers on the subject, can only be explained on the great radiation of heat from that vast extent of elevated land that rises out of central Asia like the boss of a shield, creating, as it were, a new atmosphere of its own. "As the heat," says the Baron de Humboldt, "of high regions of the atmosphere depends on the radiation of the plains, it is conceived that, under the same geographical parallel, one may not find in the system of transatlantic climates the isothermal lines of the same elevation above the level of the sea, as in the system of European climates." For the same reason, the system will apply still less to the climates of central Asia. The same philosopher has observed, that the Cordilleras of the Andes, though they extend from north to south 120 degrees of latitude, are not more, generally speaking, than from two to three, and very rarely from four to five degrees in breadth; but the vast surface of table-land, supported by the great Himalaya buttress, stretching from Daouria on the east, to Belur-tagh on the west, through 47 degrees of longitude, and from the Altai on the north, to the Himalaya on the south, through a mean breadth of 20 degrees of latitude, presents a *plateau*, more or less elevated, equal to above three millions of square miles.

In confirmation of the great influence of radiated heat from extensive elevated plains, we have now some strong facts both in America and Asia. Thus, on the mountains which rise out of the elevated plain of Mexico, Humboldt observed the lower line of perpetual congelation in lat. 19°-20° at 15,090 feet above the sea, which, by the table of Professor Leslie, ought to have been at 13,560, making a difference between fact and theory of 1530 feet. The lower point on the side of Chimboraço, nearly under the equator, was 15,746 feet, being only 656 feet higher than on the mountains of Mexico; whereas, by Leslie's table, the difference ought to be 1729 feet. Compare, again, the height of this lower limit of perpetual congelation on the side of Chimboraço with the observations of Captain Webb in the Nitee Pass, and we have the extraordinary anomaly of a place in Asia, in 30° of latitude, having that limit higher by 1253 feet than another place in America immediately under the Equinoctial Line; and at 5500 feet, or more than a mile, higher than it ought to be in that parallel of latitude, according to the theory on which Professor Leslie constructed his table. *

It is right to observe, however, that the same anomaly exists, though in a less degree, on the southern face and abutments of the Himalaya range. Thus the elevation of Kedar-nath, at 12,000 feet, is below the verge of perpetual snow, which in Europe, on the same parallel of latitude, would be at 700 feet lower. Thus, also, the village and temple of Milem, in lat. 30°. 25′ were not only without snow at the height of 11,790 feet, but extensive fields of buckwheat and Tartaric barley were growing at that elevation. In the same degree of latitude the same height in Europe would be some hundred feet within the limits of perpetual snow. At the same height, on the 21st June, Captain Webb's encampment was surrounded with flourishing woods of oaks, of the long-leafed pine, and the arborescent rhododendron, and the surface was clothed with a rank vegetation. On the following day he determined the elevation of *Pilgointi-churhai* pass to be more than 12,700 feet above the sea; yet here even no snow was visible, but the black soil was clad with creeping plants; and the shoulder of a mountain rising still higher was without a vestige of snow, and appeared, as far as could be seen through the mist, enamelled with flowers. The reflected heat from the perpendicular face of the immense mass of naked rock, on which

* See the Article CLIMATE in this *Supplement*.

snow cannot rest, exposed to the rays of a south-western sun, will probably be deemed sufficient to explain the anomaly which is found to exist on the southern side of the chain.

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Of the geological strata of these mountains we have yet but little information. Mr Baillie Frazer, who penetrated to the very base of the great chain, at the head of the Jumna and the Bhagarathe branches, describes the first and inferior hills of sandstone, more or less destructible, of indurated clay with beds of rounded pebbles and gravel. The second ridge of hills, rising to the height of 1500 to 5000 feet, are sharp, rough, and run into numerous ridges, divided by deep shaggy dells; and the crests of the ridges are frequently so sharp that two persons can hardly stand abreast upon them. Beyond these are a mass of hills entirely composed of limestone, of a round, lumpish, rugged character, whose highest points may be from 5000 to 7000 feet. Next to these commences the schistus, or slate, which continues to the very roots of the snowy mountains. All above appeared to be a striated hard grey gneiss, and a compact granite, which, Mr Frazer supposes, is the material which constitutes the highest ridges and crests of this great mountain range; but schistus is the rock that mostly predominates. Hot springs are found on both sides of the Himalaya, and copper, lead, and iron, are commonly met with. Gold is also found in the beds of the rivers. Captain Webb obtained the petrified bones of an animal of the deer kind, which were dug out of a bed of gravel, on the side of the Caillas mountain, at least 16,000 feet above the level of the sea, a height at which, it may safely be asserted, no other organic remains have hitherto been discovered. (K.)

HOLLAND. See NETHERLANDS, Kingdom of.

HOLLAND, NEW. See SOUTH WALES, NEW.

HOME (JOHN), a Scottish dramatic writer of great celebrity, was born at Leith, on the 13th September 1722. His father, Mr Alexander Home, was Town-Clerk of that place, and his mother was a daughter of Mr John Hay, a writer, or solicitor, in Edinburgh. He acquired the elementary branches of his classical education under Mr Hugh Millar, master of the grammar school of Leith, and entered the University of Edinburgh in 1735, where he soon contracted an intimacy with William Robertson, William Wilkie, Alexander Carlyle, Hugh Blair, John Blair, Sir Gilbert Elliot, Sir John Dalrymple, and several others, afterwards well known in the literary world. After having attended the Humanity Class, taught by Mr Kerr, one of the best Latin scholars of the age, Mathematics, taught by the celebrated Maclaurin, Logic, taught by Dr Stevenson, who contributed more than any other man in Scotland to inspire the young men of that period with a taste for good writing and rational investigation, he proceeded to the study of Moral and Natural Philosophy, under Sir John Pringle and Sir Robert Stewart, and then passed through the usual routine of theological instruction. He was licensed by the Presbytery of Edinburgh, as a preacher of the gospel, on the 4th of April 1745.

Before he had enjoyed many opportunities of exercising this peaceful function, Scotland became the scene of a civil war; and the ardour of his mind, imbued as it was with a love of enterprise, and a boundless admiration of military glory, prompted him, on the first news of the approach of the rebel army, to join an armed association, formed by the inhabitants of Edinburgh, for the defence of the city. On the 9th of September 1745, he was enrolled in the *College Company of Volunteers*, a corps which was dissolved within a week, when the city was taken possession of by the Pretender's troops. But Mr Home and a few other spirited young men again formed themselves into a more select and efficient company, in the month of November, and subsequently obtained permission from General Hawley to serve in the field. Of this company, Dr William M'Ghie was chosen captain, and Mr Home lieutenant. He had the command of the company on the 17th January 1746, at the battle of Falkirk, where, having received no orders to act, he was an indignant witness of the disgraceful rout of the royal forces, which had fought so well at Dettingen and Fontenoy, and having been one of the last to retreat, he was taken prisoner, with five of his company. They were sent to the Castle of Down, in Perthshire, on the 25th of January; but Mr Home, with some of his fellow prisoners, escaped on the 31st, by twisting their blankets into ropes, and dropping from the battlements, a height of seventy feet. At this time Mr Home was not less remarkable for the elegance and symmetry of his person, than for his engaging and prepossessing address. His appearance bespoke great vivacity, activity, and energy; his conversation was not merely cheerful, but uncommonly sprightly and animated; and the unceasing kindness which beamed from his countenance, and marked every action of his life, was such as to render him an universal favourite.

In the course of the year 1746, after the death of Mr Robert Blair, minister of Athelstaneford, and author of the well-known poem *The Grave*, Mr Home obtained the presentation to the living, by the interest of Alexander Home of Eccles, afterwards Solicitor-General. He was ordained to the charge of the parish in February 1747, and was very acceptable to the parishioners. During a considerable part of his incumbency, he gave the use of his manse to Mr Hepburn of Keith, a gentleman who had been engaged in both the rebellions in 1715 and 1745, and whose insinuating manners and enticing conversation in some measure reconciled Mr Home to the character of the Jacobites. He boarded himself in the house of a grazier or butcher in the village at the moderate rate of L. 12 a-year; but as he passed a great part of his time among his numerous friends in the neighbourhood, it is believed that his host was not inadequately remunerated. Mr Home was frequently absent from his lodgings from Monday morning till Saturday night, and though he wrote a considerable number of discourses for the pulpit, he seldom left himself time to finish any one of them. After writing about two-thirds of a sermon and committing it to memory, he generally trusted for the remainder to the moment of delivery. These unpremeditated perorations, occasionally eloquent, were delivered with more than his usual vehemence of action, and are said to have been not a little admired by his rustic audience.

Among the most intimate friends of Mr Home at this time were Lord Elibank, then residing at Ballancrieff, Dr Robertson, then minister of Gladsmuir, Dr Carlyle at Inveresk, and Mr George Logan at Ormiston, a young clergyman of great promise, who died soon after having been induced, by the solicitation of his ablest contemporaries, to undertake the refutation of David Hume's sceptical writings.

From his earliest years, Mr Home had been a passionate admirer of the tragic muse, and about the time of his establishment in the church, it was known to his familiar friends that he was engaged in the composition of a tragedy founded on the account of the death of Agis, as given in Plutarch's *Lives*. The play, when completed, was highly approved by his friends Blair, Carlyle, and George Logan.

In 1749, he went with this play to London, having obtained strong recommendations to the attention of several leaders of the republic of letters; but his reception was very discouraging, except among his own countrymen. Some objected to the bloodiness of the catastrophe, and to the irregular sequence of the scenes; others to the Scoticisms or vulgarisms of the style. Lord Lyttleton was then reputed the chief arbiter of taste; but no importunity could prevail upon him to read the play, because he did not like to express disapprobation, and if he happened to be pleased, he did not wish to have the trouble of supporting it; as he had lately found almost insuperable difficulty in carrying through one of Thomson's tragedies which he had warmly patronised. One Englishman of some note remarked, that the author had formed himself too much on Thomson's *Seasons* and Lee's *Plays*. "I could not have been more surprised," said Mr Home to a correspondent, "if he had told me that I had formed myself upon Euclid's *Elements* and Maclaurin's *Fluxions*." He had not a very exalted opinion of the English intellect. "I sometimes hearken to the coffee-house conversations upon poetry and politics, where there are such fellows authors whose wigs are worth L.3 Sterling, that it is ready to make a man of moderate patience *curse his better angel from his side, and fall to reprobation*." When Garrick refused to bring the play upon the stage, the author, after giving vent to his mortified feelings in an address to the shade of Shakespeare, composed in Westminster Abbey, returned to Scotland, and resumed the labours of his pastoral office, not without devoting a large share of his time to the society of his literary acquaintances, and to the pursuit of his favourite study.

He continued assiduously to cultivate the friendship of Mr Hepburn, from whose sister-in-law, Mrs Janet Denoon, he first heard the old song of *Gil Morrice*. This ballad furnished the hint on which he constructed the *Tragedy of Douglas*, in the composition of which he amused himself occasionally the next five years, submitting the successive scenes to the revision of a few friends. His own hand-writing was scarcely legible, and the play was repeatedly transcribed by Dr Carlyle. From this circumstance, and from the warm interest which that gentleman took in the success of the piece, he was commonly supposed to have had a principal share in the composition. Sir Gilbert Elliot's criticisms were acknowledged to be particularly valuable, and he also was not unfrequently reputed the author. In February 1755, Mr Home set out for London on horseback, with his tragedy in one pocket, and some clean linen in the other; and was accompanied into Northumberland by a cavalcade of clerical friends, two of whom, Carlyle and Cupples, proceeded with him a stage or two beyond Durham. This play, as well as *Agis*, was rejected by Garrick, not so much, perhaps, owing to any defect in his own taste, but because it did not contain much of that pomp and circumstance which seemed to be the chief attractions of the tragedies which were at this time favourites with the public.

While Mr Home was engaged in the composition of this play, he had not been inattentive to other affairs more nearly connected with the clerical profession. In 1752 he took an active part in the deliberations of the General Assembly, when Mr Gillespie was deposed. The year before, he had made the motion to suspend Mr Adams of Falkirk, for disobeying an order of the General Assembly, and was seconded by Dr Robertson, the first time either had spoken in that house. They were not members next year, but both spoke at the bar with great effect. About this time Mr Home's support was strongly solicited by Dr Cuming, the leader of what was then called the moderate party; but he resolved to act an independent part. He had become a great favourite of Lord Milton, nephew of the famous Andrew Fletcher of Salton; and, as his Lordship managed the political affairs of Scotland, under the direction of Archibald Duke of Argyle, he took an opportunity of introducing Mr Home to his Grace, who was much delighted with his cheerful and fascinating manners, and continued to befriend him ever afterwards. Mr Home paid a visit to the Duke, at Inverary, in October 1756, and was most kindly received. He was at this time closely connected in friendship with the members of the *Select Society*, established at Edinburgh in 1754.

It was resolved at last by the friends of the author, in December 1756, to have *Douglas* represented on the Edinburgh stage, and the result far exceeded their most sanguine expectations. Digges performed *Young Norval*; and *Lady Randolph* was personated by Mrs Ward. The theatre was crowded night after night, and the applause of the audience was tumultuous. Not only all the literati attended, but most of the judges and other grave characters, whose presence, in the theatre, excited great surprise and not a little scandal. Before this time the inhabitants of Edinburgh had not been much accustomed to dramatic entertainments, as the leaders of the church had generally had sufficient influence to induce the civil power to suppress them. In the year 1727, the Presbytery of Edinburgh issued an *Admonition against the Stage*; and, in 1733, in consequence of a sermon on the *Use and Abuse of Diversions*, by Mr George Anderson, a minister of Edinburgh, various pamphlets were published; particularly one by Mr Anderson himself, in which he denounced the stage as an unchristian diversion, and repeated all the arguments against it adduced by Prynne, Filmer, Baxter, and Collier. Following the example of their

Home. predecessors, this body issued a similar admonition and exhortation to all within their bounds on the 5th of January 1757; and not only suspended Mr White, minister of Libberton, for having been present at the performance of *Douglas*, but wrote letters to the presbyteries of Haddington, Dalkeith, Ayr, Chirnside, and Dunse, informing against those of their members who had been guilty of the same indecorum. Some of the clergymen accused were allowed to escape with a gentle rebuke; but Dr Carlyle was libelled, as it is called, by his presbytery, at the instigation, as he believed, of an eminent lawyer, then Lord Advocate, whose conduct, on that occasion, was afterwards sufficiently avenged by the ridicule heaped upon him in a humorous political satire (by Dr Adam Fergusson), entitled *The History of Sister Peg*. Several abusive pamphlets against the play and its supporters were known to proceed from the minions of this gentleman, who was then rising to a degree of consequence which soon supplanted the declining influence of Lord Milton.*

After the play had been so amazingly successful in Edinburgh, it was eagerly admitted on the stage of Covent-Garden early in 1757, but Garrick still excluded it from Drury-Lane. The triumph of the author was, however, in no small degree abated by the prosecution of his friends in the church courts, and by his own threatened deposition. The subject was brought before the General Assembly by Dr Carlyle in the form of an appeal from a sentence of the Synod of Lothian and Tweeddale; and a decision favourable to the appellant was carried by a great majority of 117 to 37. The result of this vote checked the introduction of a very severe *Overture*, which was intended to have been enacted into a law; and next day another motion was substituted, so lenient as to be seconded by Mr Dempster of Dunnichen, the friend of Home and Carlyle,—in consequence of which the Assembly passed a declaratory law, prohibiting the clergy to attend the theatre, but not discharging them from writing plays. Immediately afterwards, Mr Home thought it expedient to resign his charge; and having preached a most pathetic sermon, which deeply affected his congregation, he took leave of them in the beginning of June 1757, without having incurred any ecclesiastical censure. He then retired for three months to private lodgings at Braid, near Edinburgh, where he gave the finishing hand to the paly of *Agis*.†

From the moment when Mr Home resigned his living, the prospects of his worldly prosperity began to brighten. The people of England, ever alive to sentiments of compassion, regarded him as a victim to the rigour of Presbyterian bigotry; and though their critics decried the merits of *Douglas*, as being a faulty and languid composition, not sufficiently re-

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* The following are some of the most remarkable pamphlets published on this occasion:

1. *Admonition and Exhortation of the Presbytery of Edinburgh.* 2. Witherspoon's *Serious Enquiry into the Nature and Effects of the Stage.* 3. *The Immorality of Stage Plays in general, and of the Tragedy called Douglas in particular, briefly illustrated.* 4. *The usefulness of the Edinburgh Stage seriously considered.* 5. *The Tragedy of Douglas analysed.* 6. *A Letter to Mr David Hume on the Tragedy of Douglas.* 7. *An Apology for the Writers against the Tragedy of Douglas, with Remarks on that play.* 8. *The Deposition, or Fatal Miscarriage*, a tragedy. 9. *Douglas, a Tragedy, weighed in the balances and found wanting.* 10. *The First Night's Audience*, an excellent new ballad. 11. *The Stage or the Pulpit*, two parts. 12. *The Apostle to the Theatre his Garland.* 13. *The Finishing Stroke, or Nothing*, a ballad. 14. *The Infernal Council*, an excellent new ballad. 15. *A Song or a Sermon*, a new ballad, Saturday, 29th January 1757. 16. *The Admonition*, an execrable new ballad. 17. *Advice to the Writers in Defence of Douglas.* 18. *An Epilogue to the Tragedy of Douglas*, spoke by the Author. 19. *An Argument to prove that the Tragedy of Douglas ought to be Burnt by the Hands of the Hangman* [ironical, by Dr Carlyle]. 20. *The Moderator*, Nos. 1. and 2. 21. *Votes of the Presbytery of Edinburgh*, 29th December 1756. 22. *A Letter to the Reverend the Moderator, &c. of the Presbytery of Haddington.* 23. *A Letter to the Author of the Ecclesiastical Characteristics.* 24. *The Morality of Stage Plays seriously Considered* [by Dr Ferguson]. 25. *Some serious Remarks on a Pamphlet, entitled the Morality of Stage Plays seriously Considered* [By the Rev. Mr Harper, an Episcopalian clergyman]. 26. *The Players' Scourge.* 27. *A Letter to the Author of the Ecclesiastical Characteristics.* 28. *A Second Letter to the same.* 29. *Unto the Right Ethereal the Siplers, the Petition of Poor Alexander Bonum Magnum.* Most of these are unfavourable to the play (some of them written by Mr Maclaurin, afterwards Lord Dreghorn); others contain very indecorous strictures on the conduct of Drs Cuming, Walker, and Webster, who were active in discouraging the attendance on the theatre, and in prosecuting offending brethren.

† The presbytery of Edinburgh and other church judicatories were much derided for their illiberality by the English. So lately, however, as the year 1818, the stage has encountered as strenuous opposition from the clergy in some populous towns of England as it received in those days from the sterner Presbyterians of Scotland.—See *Short Struggle for Stage or no Stage*, originating in a Sermon preached in St James's Church, Sheffield, by the Rev. T. Best. Mr Mansel, of the Theatre, Sheffield, is opposed in this controversy by five other clergymen in Sheffield, besides Mr Best; and is supported by some anonymous writers, who quote Watson Bishop of Llandaff, Dr Johnson, and Mr Addison, in favour of the theatre. The opposition appears to have extended to Bristol and other great towns; but the most powerful defence urged by Mr Mansel rests on a ground which could not have been taken in Scotland. He says, that the theatre cannot be sinful, as it is often countenanced by the presence of the King, the head of the English Church, and its performances are sanctioned by the authority of an act of Parliament, having thus the approbation of the Bench of Bishops, as well as of his Majesty.

Home.

lieved by either pathos or elegance of expression, they admitted that it exhibited unquestionable indications of true poetic genius, and a power of awakening the most elevated as well as the most tender emotions. Men of the highest rank and influence expected to gain popularity by patronising the author, who, after being known to possess the good graces of the Dukes of Cumberland and Argyle, was warmly recommended by his friend, Sir Gilbert Elliot, to the Earl of Bute, who then superintended the education of the Prince of Wales, afterwards George III. The Princess Dowager of Wales gave him a pension of L. 100 a-year, an allowance equal to the value of the living which he had resigned; and assurances were given him of a more ample provision at no distant period.

In one respect, the partiality of his literary friends, and the favour of the great, had an injurious effect on his future fame, not only by producing an impression that he gained by flattering assiduities what merit alone was seldom known to procure, but by exciting expectations in the minds of numbers that his more mature exertions would far surpass the earliest specimen of his powers as a dramatic writer. The warm encomiums of David Hume were naturally ascribed to the partiality of friendship; but the opinion expressed by Gray the poet, that the tragedy of *Douglas* had "retrieved the true language of the stage, lost for three hundred years," seemed to imply a preference of the muse of Home even to that of Shakspeare himself. The objections of Garrick to the tragedy of *Agis* were no longer urged; and though this was in fact the earliest effort of an unpractised writer, it appeared under the disadvantage of being considered as a work of higher pretensions than that which had already been so well received by the public. It is also to be presumed, that, though in its finished state it retained many lofty sentiments of freedom and patriotism, yet, as the author began to breathe the atmosphere of a court, he was tempted to soften some of his boldest images; so that the piece may have lost in spirit more than it gained in polish. It was brought out at Drury-Lane in 1758, and, partly owing to the admirable acting of Garrick in the character of Lysander, had a successful run of nine nights. The author cleared several hundred pounds, but the anticipations of the public were not fulfilled. "I cry," said Gray, "to think it should have been by the author of *Douglas*. Why, it is all modern Greek. The story is an antique statue, painted white and red, frizzed and dressed in a negligee made by a Yorkshire mantua-maker."

In 1759, the *Siege of Aquileia* was first performed at Drury-Lane, but was by no means so successful as Garrick had expected. Garrick and Home were now on the most intimate footing; and as Home listened with much deference to the criticisms of this great actor, and generally followed his advice,—he, on the other hand, courted the good graces of Home, by consulting him in his difficulties, and soliciting him to act as his friend, or second, in certain quarrels, which threatened to terminate in duels. Early in 1760, Mr Home's three first plays were published in one volume, which was dedicated to the Prince of Wales.

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After the accession of the Prince to the throne, the Earl of Bute became Prime Minister; and from this period Mr Home for many years lived constantly with his Lordship, at least from October to May, and was well known to possess the first place in his confidence and favour. Mr Home was always most active in promoting the interest of those who called themselves his friends, and conferred the most valuable obligations on many individuals, who were more forward to solicit his services than to testify their gratitude. But it is well known, that he never teased his patron with applications in his own behalf; and it is believed, that he might have been overlooked altogether, if Lord Bute had not been prompted by another friend to bestow upon him some honourable and lucrative appointment. A pension of L. 300 a-year was granted to him in July 1762, and another of equal amount was at the same time conferred on Dr Johnson. In the course of the following year, the place of *Conservator of Scots Privileges at Campvere* was bestowed upon him, the value of which appointment was also L. 300 a-year; and from this period his name appears annually in the list of members of the General Assembly, as elder for the church of Campvere, under the title of *Lord Conservator*. He regularly attended the meetings of the Assembly, and took a lively interest in the proceedings. He had little turn for business, but he occasionally spoke with much energy and effect. He was ambitious to have a seat in the House of Commons, and repeatedly signified his wishes, which at one period might have been easily fulfilled, if he had not been dissuaded by Sir Gilbert Elliot and Sir William Pulteney, not only because they knew that he would be considered as disqualified, by having been in orders, but because they were convinced that, even if that objection were not started, he would make no great figure as a debater. When in London, he lived on terms of great cordiality with Armstrong, Smollet, Dr Pitcairn, Dr William Hunter, Mr Wedderburn, afterwards Chancellor, and the Honourable Charles Townshend. He had a particular pleasure in fostering rising merit. In the year 1759, he stimulated James Macpherson to collect what were called the *Poems of Ossian;* and he afterwards accompanied him on one of his tours, partly with the hope of sharing in the pleasure of discovering the poetical remains of distant ages, but chiefly with the purpose of searching for materials which might throw light on the history of the rebellion in 1745.

In 1769, his tragedy of *The Fatal Discovery*, the fable of which is borrowed from one of the fragments ascribed to Ossian, was performed at Drury-Lane, with indifferent success. At this time, the prejudice against Scotsmen was so strong in London, that Garrick apprehended a total failure of the play if the author were known. At his suggestion, therefore, the title was altered from *Rivine* to *The Fatal Discovery;* and for some nights the representation was greeted with loud applause, the play being ascribed either to Gray or to Smith. Mr Home's love of praise, however, betrayed the secret, and from that moment the audience sensibly diminished every night. In February 1773, *Alonzo*

was brought out, and was well received. This play is recommended by the simplicity of the plot, the harmony of the versification, and the dignity of the sentiments; but some of the incidents are improbable, the language occasionally too mean, the apostrophes too frequent, and it has more eloquent declamation than natural feeling, more graceful description than pathetic effect. The acting of Mrs Barry affected the feelings of the audience so powerfully as to disarm the severity of criticism. To this tragedy, as well as to the *Fatal Discovery*, Garrick furnished an epilogue. The theatrical career of Mr Home was closed with the play of *Alfred*, which was represented at Drury-Lane in January 1778. It was listened to the first evening, but a less crowded house was never known than on the second, and after the third performance the author withdrew it.

For many years Mr Home lived chiefly in London. In 1767, he obtained from Sir David Kinloch a long lease of Kilduff, a farm in East Lothian, on which he built a house. In 1770, he married Miss Home (daughter of Mr Home, minister of Fogo, formerly of Polwarth), a lady of very delicate constitution, who, however, survived him several years.

In 1778, when the Duke of Buccleuch raised the regiment of *South Fencibles*, Mr Home's military ardour induced him to accept a commission as lieutenant, the same rank which he had held more than thirty years before; and he gave occasion to some sneers from his graver brethren, by sitting in the General Assembly in his scarlet regimentals. After being nearly two years an officer, he was disabled for military service by a fall from his horse, which, though it did not permanently affect his health, continued through life to impair the vigour of his faculties, and to diminish the flow of his spirits. About this time he left Kilduff, and took up his residence in Edinburgh for the remainder of his life. Till within five years of his death, he was accustomed to pay an annual visit to London; and such was the force of habit, that his friends experienced great difficulty in prevailing upon him to desist from these expensive and unnecessary journies.

In 1798, an edition of his plays was published, in two volumes, now rarely to be procured.

His last work, the *History of the Rebellion in 1745*, was published at London in 1802, in a quarto volume. It had long been understood to be in a state of perfect preparation, but it was not expected to appear in the author's lifetime, as there was reason to apprehend that much of the matter which it contained would prove offensive to some distinguished individuals, whose hostility it was not desirable to encounter. In the first sketches of it, the author is said to have ardently applauded the disinterested motives and gallant conduct of the adherents of the house of Stuart, to whom he had been opposed in the field; and while he did ample justice to their devoted attachment and heroic efforts, he was not sparing of the indignation due to the barbarities perpetrated by the prevailing party after the victory of Culloden. Some influence, however, was exerted to hasten the publication, and the author had not the courage to resist the temptation to suppress and qualify many of his first statements. As a composition, it was certainly not improved by what were intended as the finishing emendations; but, if its interest has been weakened, its impartiality has probably been more effectually secured than if it had retained its original form; and, though the book gave much less satisfaction than if it had not been so anxiously expected, its merit has certainly been unduly depreciated. The style, indeed, is negligent, and the reflections not profound; but if the comments of the author are few and obvious, the detail is generally so full as to enable the reader to draw just conclusions; the battles are graphically described, and so far as the narrative extends, it is entitled to unreserved credit. Perhaps the chief cause why the work was never highly applauded has been, that it is not written so as to gratify the prejudices either of one party or another.

Mr Home died at Merchiston, in the neighbourhood of Edinburgh, on the 5th of September 1808, when he had nearly completed his 86th year. In private life no man was ever more entirely beloved. His affections were equally warm and stedfast, and much as he had moved in the highest circles (not without pluming himself sufficiently on his intimacy with the great), he never forsook the interest of his friends in humbler stations, or betrayed any expectation of deference from those who were dependent on his good offices. His temper was placid, and though there were occasions on which he manifested some warmth of feeling, he was neither apt to resent injuries, nor to inflict pain. He was never known to grudge any exertion which tended to benefit or gratify his friends; and long after the activity of his mind had begun to languish, he continued as eager as ever to confer unsolicited favours, and to use all the influence which he possessed to reward neglected merit. He was alleged to be rather apt to flatter; but the fact was, that he appeared never to discover any defects in the character of those whom he esteemed; and with all the blindness of a lover to the objects of a first attachment, the overflowing benevolence of his heart disposed him to invest his early friends with every perfection of which human nature is susceptible, and to spread the veil of charity over blemishes and offences. If he had not been early enticed into the vortex of fashion and politics, he might have attained higher eminence as an author; but, in spite of all the temptations of vanity, and the petulant and persevering attacks of envy, he could scarcely, under any circumstances, have proved more amiable as a man.

It is earnestly to be hoped that the world will ere long be favoured with the very interesting *Account of the Life of* Mr Home, which was read some years ago to the Royal Society of Edinburgh by Mr Henry Mackenzie; an author whose works may be considered as the channel through which the stream of poetic fancy and feeling has been transmitted from Thomson, Home, and other Scottish writers of the last age, to the Campbells and Scotts of the present day. (C. C. C.)

HORTICULTURE.

Horticulture.

Under the article Gardening, Practical, in the *Encyclopædia* (Vol. IX. p. 411), there is an ample detail of the operations of horticulture, for each month of the year, in the Kitchen Garden, the Fruit Garden, and the Flower Garden. Since that article was written, however, considerable improvements have taken place; and of these we propose now to give an account. It would be difficult to treat of subjects so numerous and multifarious in a connected discourse. Instead of attempting this, we shall rather study not to omit any thing of importance, trusting that we shall thus enable the reader to form a tolerably just estimate of the present state of British Horticulture.

The simple and natural division into Kitchen, Fruit, and Flower Garden, adopted in the *Encyclopædia*, shall here be adhered to.

KITCHEN GARDEN.

Under this head, we may give the first place to the improvement which has taken place in the culture of Sea-Cale; and of this we shall treat pretty fully.

Sea-Cale.

Sea-Cale.

The cultivation usually recommended consisted merely in covering the shoots, at the approach of spring, to the depth of a few inches, with dry earth, or with sand or gravel, in order to the blanching and intenerating of the shoots. These were cut as they appeared in March and April. Now, however, the blanching is not only much more completely effected, but simple means have been devised of supplying the table with shoots for half the year, including all the winter months. It has of late become a market vegetable, and appears plentifully on the stalls of Covent-Garden, and more sparingly on those of the Edinburgh green-market. It is somewhat remarkable, that, in regard to this excellent culinary article, we have decidedly anticipated our neighbours the French. The *Manuel du Jardinier* for 1807 speaks only of the *leaves* being used, and, justly enough, condemns them as coarse. In the recent editions of the *Bon Jardinier* (1818, 1819), the blanched shoots are at last recommended, and the English mode of culture is mentioned. But this mode of culture is not yet practised in the *marais* of Paris, and sea-cale shoots will still be looked for in vain in the celebrated *marché aux herbes* of that capital.

Mode of Culture.

The practice of the best cultivators shall here be described.—It is considered proper that the sea-cale bed should be trenched at least two feet deep. The soil should be rather light, and should have a dry bottom. If manure be added, it ought to consist of sea-weed, or of tree-leaves well rotted; the shoots being very apt to imbibe a disagreeable flavour from recent dungs and coarse manures. The plant may be propagated by offsets, or by small pieces of the root, having eyes or buds attached to them; but it rises freely from the seed: this is sown in March, generally in patches of three or four seeds, placed four or five inches separate, leaving fully two feet between each patch. During the first two years, the chief things to be attended to are hoeing and weeding, and rejecting any superfluous plants, in case all the seeds may have germinated. At the approach of winter, some gardeners throw a little light stable-dung over the whole surface of the bed: a covering of fresh sandy soil, to the depth of two inches, answers equally well. In the third year, the plants become fit for blanching; and if the sea-cale bed be judiciously managed, it will continue productive for several successive years. In order, however, to ensure a succession of young and vigorous plants, and to provide for the bad effects of forcing, which is generally destructive to the plants subjected to it, it is proper to sow a small bed of sea-cale yearly. Fresh seed may always be kept in readiness, by allowing two or three plants to produce their flowers and seeds each year; the flowers, which are white and smell of honey, appear in May, and are followed by the seeds in September.

Blanching.

Various modes of blanching the shoots have been resorted to. In the first volume of the *Memoirs of the Caledonian Horticultural Society*, Sir George Mackenzie describes a very convenient method. The sea-cale bed is merely covered, early in the spring, with clean and dry oat-straw, which is removed as often as it becomes wet or musty. The shoots rise through the straw, and are at the same time pretty well blanched. Mr Barton, formerly gardener at Bothwell Castle, employed tree-leaves for this purpose. When these naturally fell in the end of autumn, he caused them to be swept together, and laid over the sea-cale bed to the depth perhaps of two feet. He found that a thin covering of stable dung, sufficient only to keep the leaves from being blown about, was useful in forwarding the production of the sea-cale shoots, a slight fermentation being thus induced. The shoots rise sweet and tender among the leaves, in the early part of spring; but it it must evidently be difficult in this way to regulate the heat of fermentation, and safer to avoid it. Another method practised by many gardeners consists in placing over each plant a flower-pot of the largest size, inverted; and *blanching-pots*, constructed for this express purpose, are described by Mr Maher in the first volume of the *Transactions of the Horticultural Society of London.* These have since been much improved, by fitting them with moveable lids, the utility of which will presently appear. Such pots, we may remark, should not be made to taper much at top; but should be nearly of equal width throughout, in order to give room for taking off such shoots as are ready, without injuring the others. It may be proper to provide from thirty to sixty pots; and it may be expected that each pot will, on an

average, furnish a dish and a half of shoots during the season.

With the aid of these pots, sea-cale is now *forced* in a very simple way, in the open border. In the latter end of the autumn, a bed of vigorous sea-cale is dressed off, that is, the stalks are cut over, and all decayed leaves are removed. The ground is at the same time stirred or loosened around the plants, and a thin stratum of fine gravel or of sifted coal-ashes is laid on the surface, in order to keep down earth-worms. A pot with a moveable cover is placed over each plant, or over each patch of plants, if two or more have remained together. Stable litter is then closely packed all around the pots, and pressed firmly down; and successive quantities are added, till the pots be buried to the depth of a foot or more; the whole thus assuming the form and appearance of a large hot-bed. When fermentation commences, a thermometer should occasionally be introduced into a few of the pots, in order to ascertain the temperature within, which should never exceed 60° Fahr. The depth of the covering of litter, therefore, is to be increased or diminished, according to the state of the fermentation, and partly according to the severity of the season. The vegetation of the included plants is speedily promoted; so that, in the space of a month, the most forward shoots will probably be ready for cutting. The shoots thus produced, being completely excluded from the action of light, are most effectually etiolated, and exceedingly tender and crisp. The advantage of the moveable lids must now be evident: the state of the plants or stools can be examined, and such shoots as are ready can be gathered, without materially disturbing the litter or dissipating the heat. This simple mode of forcing sea-cale has every where superseded the practice of planting it on hot-beds under glass-frames, formerly recommended by Abercromby and other writers on horticulture. This vegetable, it may be remarked, in one respect forms an exception to all others: it is of better quality, when forced in the midst of winter, than when produced naturally in the spring season.

By the modes of culture which have now been described, sea-cale shoots can readily be furnished fresh for the table, from the middle of November till the middle of May.

Rhubarb Stalks.

These are now so much in demand for the making of tarts, that they have become a leading article of trade with the green grocers of London and Edinburgh. The practice of using them seems peculiar to this country; at least it is unknown to the French, the Dutch, or the Germans. The stalks at present sent to market are evidently of finer quality than in former years. By the mode of culture practised, especially the employment of young seedling plants only, the frequent removal of the leaves, and preventing the plant from flowering, the leaf-stalks are rendered more tender than those of plants which have been long established in a garden. Indeed, some of the varieties which have been raised from seed, especially by Messrs Peacock of Edinburgh, have leaf-stalks of a more succulent nature than usual. These appear to be intermediate varieties; and have been raised from seeds yielded by plants of Rheum rhaponticum, growing close by R. hybridum, compactum, and Sibiricum,—the leaf-stalks of which species are used indiscriminately. Such succulent stalks, when peeled, cut down and baked into tarts, have all the appearance of apples, and are by many people preferred to them. In the open ground the stalks are produced from April till midsummer. The progress of vegetation may be hastened during the month of March, by throwing over the plants some loose haulm, care being taken not to injure the shoots, which at that season are very brittle.

Forcing of Rhubarb.

Rhubarb may be forced, much in the manner above described for sea-cale; and the leaf-stalks are thus not only rendered tender, but, being at the same time blanched, become of a fine light colour, and have less of the peculiar flavour of the plant, which is an advantage. The smaller species, such as R. crispum and undulatum, are best for this purpose, being most easily confined within the covers. In the third volume of the *Transactions of the London Horticultural Society*, a mode of forcing the rows of rhubarb, by means of an open frame of wood-work, surrounded with stable litter, is described. Stakes between three and four feet long are driven into the ground opposite to each other, on each side of the row of plants, making the included bed or row two feet wide. The stakes are contracted at top, or made to slope inwards, by means of connecting cross pieces, fifteen inches long. Two or three lath-spars are nailed horizontally along the side stakes, in order to keep the litter from falling in upon the plants. The lining of dung should not be less than eighteen inches thick; the longest litter should be reserved for the top, so as to be easily removed when the state of the interior is to be examined. This plan is well adapted for forcing and blanching the larger species of rhubarb, which could not be confined within sea-cale covers.

Mr Knight (who gives his attention equally to humble details of practical utility, and to philosophical speculations connected with horticulture, and whose name will often fall to be mentioned in this article) has described a method of forcing rhubarb by planting in pots. In the beginning of winter a number of roots of rhubarb are dug up, and placed in some large and deep pots, each pot being made to receive as many as it will contain. Some fine sandy loam is then washed in, so as closely to fill the interstices between the roots, the tops of which are so placed as to be level with each other, and about an inch below the surface of the mould in the pots. The pots are placed in any kind of hot-house; and other pots of the same size are inverted over them. If water be freely supplied, vegetation proceeds very rapidly: three successive crops of leaf-stalks may generally be obtained. The shaded spaces of vineries or peach-houses, which are generally wholly unoccupied, are exceedingly well suited for forcing rhubarb in this manner.

Kitchen Garden.

Brussels Sprouts.

Brussels Sprouts.

This culinary vegetable, which is allied to the savoy, originated long ago in the Low Countries, and, as may be inferred from the name, is much cultivated in the neighbourhood of Brussels, where it is called *Chou à jets.* From the axillæ of the stem-leaves proceed small rosettes or sprouts, which resemble savoy cabbages in miniature: these by degrees push off and supplant the main leaves. The sprouts are very delicate when boiled, and justly held in estimation for the table. The culture is nearly the same as that of other coleworts. The seed should be sown in the spring months, and the seedlings planted out before midsummer, during showery weather. The plants grow tall, often three feet, and the sprouts closely surround the stem, the whole forming a narrow pyramid; they may therefore be placed more near together than others of the cabbage tribe, or they may be planted between rows of winter spinage or other low growing crops. In October the plants should have additional earth drawn towards their roots, to firm them, and save them from being destroyed by the frost. The earliest sprouts become fit for use in November; and, if the weather be mild, they continue good, or even improving in quality, till the month of March following. Two or three plants of the most genuine character, with the rosettes small and closely set on the stem, should be allowed to run to flower, in order to secure a supply of true seed. From February till April, Brussels sprouts are now very common in the London market; but they are only beginning to be cultivated in the sale-gardens at Edinburgh.

Mr Van Mons of Brussels mentions (*Lond. Hort. Trans.* Vol. III.) that, by successive sowings, the sprouts are there obtained for the greater part of the year. The tops of the plants are commonly cut off a fortnight before beginning to gather the sprouts; this, it is thought, promotes the production of rosettes. The sprouts are preferred when small or young; if they be more than half an inch in diameter, they are thought too large. In the spring, when the plants have a tendency to run to flower, their growth is checked, by lifting them and replanting them, in a slanting direction, in a cool shady situation.

Cape Broccoli.

Cape Broccoli.

This is an early purple variety, which was introduced a few years ago, from the Cape of Good Hope, according to some, and from Italy according to others. It is a fine kind, being of a delicious flavour when dressed; but on account of the plant being very apt to start into flower, its cultivation has in many places been neglected. When the crops are properly managed, however, this tendency can be overruled. Two crops should be sown; the first in the middle of April; the next in the middle of May. The first sowing may be made on any border of light soil, scattering the seed very sparingly. In about a month the plants may be transplanted, directly from the seed-bed, into a quarter consisting of sandy loam, well enriched with rotten dung. They should not stand nearer than two feet apart every way. Frequent hoeing is proper, and the earth should be drawn to the stem, as in the case of common broccoli. The greater part of the second crop should be planted in pots likewise directly from the seed-bed. These pots are to be sunk in the open ground till the broccoli heads be formed. In the end of November, the pots are to be raised and placed under a glass-frame; and in this way very fine broccoli may be produced in the severest weather of winter. In August, a small sowing should be made in a frame, by which means the plants are somewhat forwarded, without being rendered more tender; these are planted out about the middle of October, three or four together, and protected by hand-glasses during winter. The principal use of this last sowing is to secure the possession of a few good plants in the spring, which may furnish a supply of proper seed.

Mr Knight's New Pea.

Knight's Marrow Pea.

It was on the pea, it may be observed, that Mr Knight first made his experiments, many years ago, on the fecundation of one pistillum, by pollen taken from different varieties of blossom, white and grey. In the course of these experiments, he obtained the new pea now to be described. The plant is of luxuriant growth, generally rising to the height of eight or ten feet: in exposed situations it is apt to be injured by the winds; but in sheltered places, and with the aid of tall stakes, it proves extremely productive. The blossoms are white and of large size; and both the legumes (or cods) and the seeds (or peas) are large. The peas are of a cream colour; immediately as they begin to dry, they shrivel or contract in some degree; and, from this circumstance, the name of *Wrinkled Pea* is often used, particularly among seedsmen. The flavour of the peas, when boiled, is peculiarly rich, surpassing that of any of the other marrow peas: they have been found to abound more in saccharine matter than any others. It is a late pea, and should not be sown before April or May. It makes an excellent principal crop; and it may be added, that it retains its flavour in the autumn better than any other, and should, therefore, be preferred for the latest sowings.

Late Crop of Peas.

The mode in which Mr Knight manages his autumnal crops of this pea may here be mentioned, because it generally has the effect of keeping them free from the attack of mildew. The seed for these crops is sown, at intervals of ten days, from the beginning to the end of June. The ground is dug over in the usual way, and the spaces to be occupied by the future rows of peas are well soaked with water. The mould upon each side is then collected, so as to form ridges seven or eight inches above the previous level of the ground, and these ridges are well watered. The seeds are now sown, in single rows, along the tops of the ridges. The plants grow vigorously, owing to the depth of soil and abundant moisture. If dry weather at any time set in, water is supplied profusely once a week. In this way the plants continue green and vigorous, resisting mildew, and not yielding till subdued by frost.

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Mouse-Peas.

-Peas. Under this name, a species of Lathyrus (L. tuberosus) is by some persons cultivated for the sake of the tuberous roots, which being perhaps two inches long, and having a fibre at one extremity, may easily be fancied to resemble mice. When the tubers are of the size mentioned, they are considered fit for use. They are cleaned, and, being firm and hard, boiled for a long time, two hours or more, till a fork will pass through them: they are then dried, and slightly roasted; when they are served up in a cloth, in the manner of chesnuts. They are merely calculated for the dessert, and in Holland and Flanders they are not uncommonly used for that purpose.

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re. Mr Dickson, of Croydon, has described the most approved mode of cultivation. *(Lond. Hort. Trans.* Vol. II.) He recommends the forming of an appropriate border for the plant, inclosed with brick-work, twenty inches deep, and also paved with bricks in the bottom. This bed is filled with a light but rich soil. In this way the roots are restrained from penetrating deep, which they would otherwise do; and the formation of tubers is at the same time promoted. The plant is easily propagated by the tubers, which should be placed six inches apart, and three inches below the surface. The bed should not be disturbed till the second year; after which it will continue productive for a long time, if dug in regular course from one end, leaving the smaller tubers to produce a succession of plants, and adding some good rich soil every year.

Onions.

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ns. The cultivation of the onion has been greatly improved by the practice of transplanting. This mode has been recommended in England by Mr Knight, and in Scotland by Mr Brown at Perth, and Mr Macdonald at Dalkeith.

Knight's
e. Mr Knight's plan consists in sowing the seed, preferring the variety called White Portugal Onion, at the usual spring season, thick under the shade of a tree, and in poor soil. In the autumn the bulbs are small, scarcely exceeding in size the dimensions of large peas, but of firm texture. They are taken from the ground and preserved till the succeeding spring, when they are planted at equal distances from each other, perhaps six inches in every direction. The plants thus produced differ in no respects from those raised immediately from seed, but in possessing greater strength and vigour, owing to the quantity of previously generated sap being greater in the bulb than in the seed. In this way, two of our short and variable summers produce the same effect as one long and bright summer in Spain or Portugal, and bulbs are procured equal in size and flavour to those that are imported.

Brown's. Mr Brown's plan, which he has occasionally practised with a part of his own crop for twenty years past, is nearly the same as Mr Knight's, only he does not sow under the shade of trees, with the view of getting small bulbs; he merely collects, from the ordinary onion crop, all the small bulbs, from the size of a pea to that of a hazel-nut (which would otherwise be thrown away as refuse); and having kept these over winter, they are planted in the spring. If the sown beds at any time fail, he can always trust, he finds, to the transplanted rows forming a reserve.

Kitchen
Garden.

Mr Macdonald's. Mr Macdonald confines his operations to one summer. He sows in February, sometimes on a slight hot-bed, sometimes merely under a glass-frame. Between the beginning of April and the middle of the same month, according to the state of the weather, he transplants the young seedlings, in rows about eight inches asunder, and at the distance of four or five inches from each other in the row. Immediately previously to planting, the roots of the seedlings are dipped in a puddle prepared with one part of soot to three parts of earth. The crop being in regular rows, weeds can be destroyed with the hoe in place of the hand, and the bulbs thus enjoy the great and well known advantage of having the surface-earth frequently stirred. Onions of large size are thus produced, equal in firmness or flavour to foreign ones. It is found by experience that the transplanted onions remain free from wire-worm or rot, while those left in the original seed-bed are frequently much injured by both. The beds destined for these transplanted onions are deeply delved over in the beginning of April, and many larvæ may probably thus be destroyed; and the plants growing with superior vigour, in consequence of the repeated hoeings, must be better able to resist the attacks of insects. Possibly the soot-puddle may also be beneficial, by tending to repel the larvæ till the bulbs be too strong to be attacked. Mr Macdonald finds the Strasburg or Deptford onion answer equally well for transplanting as the Portugal or Reading onion.

Potatoes.

Potatoes. The varieties of the potato cultivated in Britain, having been chiefly derived from Ireland, where the plant is nearly secure from frost from the middle of April till the end of November, the want of new and more hardy varieties has long been felt; and the Horticultural Societies both of London and Edinburgh have offered premiums for the production of such varieties. A hardy potato is, however, still a *desideratum*.

Various new kinds, some of them possessing desirable properties, have indeed, of late years, been raised by cultivators in different parts of the country; but to particularize these seems unnecessary. It may, however, be remarked, that while the Ash-leaved and American Earlies are the kinds with which the Edinburgh market is principally supplied in the months of July and August, a superior early variety abounds even in the neighbouring town of Perth. This is called the Royal Dwarf. The plant is distinguished by its broad shining leaves, and by the first tubers forming a cluster of three or four immediately at the bottom of the stem. This last circumstance renders it easy to rob the plant of the earliest and largest potatoes, without disturbing the roots, leaving it to produce a sufficient crop of secondary tubers for seed-stock. The royal dwarf is a dry potato, or rather mealy than waxy; but this is a quality which recommends it to many persons. It is generally fit for use a fortnight earlier than the ash-leaved or the American early. It may be re-

Early Royal Dwarf.

marked, that the most desirable early varieties are such as do not show a disposition to send forth flowers; that portion of the substance and vigour of the plant which would go to the formation of flowers, being diverted to the production of tubers.

Prevention of Curl.

A very important fact in the cultivation of potatoes was observed, about the year 1806, by the late Mr Thomas Dickson of Edinburgh, viz. that the most healthy and most productive plants were to be obtained by employing as seed-stock tubers which had not been thoroughly ripened, or even by planting only the wet or least ripened ends of long-shaped potatoes. Mr Knight has likewise clearly shown the advantage of using, as seed-stock, potatoes which have grown late in the preceding year, or have been only imperfectly ripened. It is important to know, that if a valuable kind seem to be exhausted or to have lost its good qualities, it may be restored merely by planting the tubers late in the summer, and preserving the produce of this late-planting for seed-stock.

Production of Young Potatoes during Winter.

The forcing of early potatoes on hot-beds has long been practised; but it is attended with considerable trouble and expence. Small supplies of young potatoes are now commonly produced, during winter, in boxes placed in the mushroom-house, in the shade at the back of a hot-house, or in a common cellar, if beyond the reach of frost. In October, old potatoes are placed in layers in the boxes, alternating with a mixture of tree leaves, sand, and light mould, until they be full. Vegetation soon proceeds; and there being no opportunity for the unfolding of stems and leaves, the energies of the plants are expended in the production of young tubers. Before midwinter, these often attain the usual size and appearance of early potatoes; but they are much inferior, being of a watery taste, and having little or no flavour.

Storing and Keeping.

It is much to be wished that we should be acquainted with improved modes of storing the principal autumnal crop, so as to preserve the quality unaltered till the following summer. The Reverend Dr Dow, of Kirkpatrick-Irongray, has devised a mode which certainly merits attention. In the autumn, the potatoes are put into small pits, holding about two bolls each. These pits are formed under the shade of a tree, or on the north side of a high wall; and they are covered with straw and earth, according to the usual mode of pitting potatoes. In the end of April, or beginning of May of the following year, the potatoes are examined; all buds are rubbed off, and such as show any tendency to spoil are thrown out. The pits being cleaned out, are nearly filled with water; when this has been absorbed, the potatoes are returned into them; at the same time, every quantity is watered as it is laid in, and the whole covered with earth, as before. The pits must, in this way, long remain cool. The abundant supply of moisture is, however, contrary to established prejudices as to the mode of keeping potatoes; and on this account, many have probably been deterred from adopting the Doctor's plan. But, in this way, we are assured, the potatoes are kept not only plump and unaltered in taste, but the dry kinds, after being seven months in the pits, come out unimpaired, and appear on the table as mealy as ever.

Turnips.

Turnips.

Nothing new occurs in regard to the culture of the turnip, unless, perhaps, the practice of sprinkling powdered quicklime over the young plants while in seed-leaf, in order to check the ravages of a little beetle called the turnip-fly.—The variety called Stone-turnip is still very much cultivated for the London market. But the Aberdeen Yellow Turnip is preferred, in many places, for use at the table during the winter months. It is hardy, and remains firm and good till the spring.—A very beautiful yellow variety has of late been cultivated, under the name of Maltese Turnip. It is of a round shape, and has such a fine golden colour and so very smooth a skin, that it resembles some foreign fruit. It is excellent for the table; but, if intended for winter use, it must be carefully packed in sand, being otherwise apt to shrivel and decay.—The Swedish Turnip, or Ruta Baga, is now preferred by many persons for the winter supply, on account of its rich flavour and agreeable sweetness. It may either be stored among sand, in a cellar, or, being extremely hardy, it may remain in the ground till wanted.—The Navew, or *Navet* of the French, is a distinct species, a variety of our native Brassica Napus. The cultivation of the French turnip was promoted in this country during the late war, owing to the numerous French emigrants creating a demand for it. The cultivation is similar to that of ordinary turnips. The root, which is oblong, or carrot-shaped, is of a much higher flavour than any of the common turnips. It is put whole into soups, after being merely scraped, not peeled.

Maltese Turnip. Ruta Baga. French Turnip.

Turnip-rooted Cabbage.

Kohl-rübe.

Of the turnip-rooted cabbage, or *kohl-rübe*, there are two varieties, one swelling above ground, the other in it. Both are occasionally used for the table, and, while in a young state, are equal in flavour to the Swedish turnip. There is nothing particular in the culture, unless that, in the case of the first-mentioned variety, the earth should not be drawn so high as to cover the globular part of the stem, or the part used. The seed may be sown in the beginning of June, and the seedlings transplanted in July: they are thus fit for use at the approach of winter; and they may either be stored like turnip, or, being quite hardy, they may be left in the ground till required.

Succory

Succory.

is, like the navew, a plant indigenous to our island (Cichorium Intybus), and we also owe its cultivation to the foreign refugees during the war. It is still but little attended to, probably less than it deserves. It is much esteemed by the French as a winter salad; and, when blanched, is known under the name of *Barbe du Capucin*. When intended for winter use, the seed is sown in June or July, commonly in drills; and the plants are thinned out to four inches apart. If the first set of leaves grow very strong, owing to wet weather, they are cut off, perhaps in

Leaves Blanched as Salad.

Kitchen Garden. the middle of August, about an inch from the ground, so as to promote the production of new leaves, and check any tendency to the formation of flower stems. In the end of September, or beginning of October, the plants are raised from the border; all the large leaves are cut off, taking care not to injure the centre of the plant; the roots are also shortened. They are then planted in boxes filled with rich mould, pretty close together. These boxes are set in any sheltered situation, and occasionally watered, if the weather be dry. When frost comes on, they are protected by a covering of any kind of haulm. As the salad is wanted, the boxes are successively removed into some place having a moderately increased temperature, equal perhaps to 55°, but not exceeding 60° Fahr. The less light they are subjected to, the blanching is of course the more easily accomplished. The mushroom-house, a corner of the green-house, or a cellar off the kitchen, will answer the purpose. Each box affords two crops of the blanched leaves, a short interval being allowed for the growth of the second crop. The leaves are reckoned fit for cutting when they are about six inches long. A more simple and easy, but perhaps less neat and less productive, mode may be mentioned. The plants may be taken from the open border at the approach of winter, with balls of earth attached to them, placed in boxes, and the interstices between the balls filled with sand. If the green leaves be cut over, and the boxes be placed in a darkened cellar, or other similar situation, a crop of blanched salad will soon be produced.

Roots as a Substitute for Coffee. When colonial produce was excluded from most of the continental markets, the roots of succory were resorted to as a substitute for coffee-beans, and many still continue to use a mixture of succory and coffee, in preference to the simple infusion of the latter. The roots are taken up when of the size of small parsnips; they are cut into little pieces, of nearly equal size; these are carefully dried, generally in an oven, so as to preserve their plumpness and avoid shrivelling; and they are afterwards reduced to a powder in the manner of coffee-beans, as needed for use. The succory root is thought to communicate to the infusion the power of acting as a gentle diuretic.

American Cress,

American Cress. although its name would lead us to expect a distant origin, is a plant indigenous to England, the Erysimum præcox of the *Flora Britannica*. It resembles the common winter-cress, E. barbarea, but is smaller; and it is only a biennial, while the former is a perennial plant. The leaves of the American cress have a pleasant warm taste; while those of the common winter-cress are rather nauseous. It has of late years been very generally cultivated as a green salad plant. It may be sown either at broadcast, or thinly in drills a foot asunder, on any light soil. Two or three successive sowings may be made during the season, in order to have young plants; but it may be noticed, that when the outer leaves are regularly gathered, new ones are produced in succession. A late sowing should be made in August or September, on some sheltered border; the plants stand the winter without injury, and afford leaves fit for use in February or March.

Melons.

The melon-ground is generally regarded as an appendage of the Kitchen Garden, and has been treated of in the *Encyclopædia* (article GARDENING, Part III.) under that head. To the ample instructions there given for the cultivation of the melon, little remains to be added, excepting a caution, founded on the observations of Mr Knight, against removing any leaves for which room can possibly be found. This is the more necessary, that many gardeners of the old school are very apt to think that, in thinning out the leaves, they are doing service, by admitting sun and air to the fruit, while they are probably inflicting a positive injury. The success of the fruit depends very much on the plant possessing a luxuriant and healthy foliage, having the upper surfaces regularly presented to the light, and remaining as much as possible undisturbed in that position. Pegs are therefore to be freely employed, not only with the view of retaining the shoots in their place, but of keeping the leaves steady and upright; and when water is necessary, it is to be introduced without touching the leaves. Melons. Importance of preserving the Leaves.

Two uncommon varieties of the melon, introduced of late years, may be shortly noticed; the Salonica and the Valentia.—The *Salonica Melon* is nearly of a spherical shape, and without depressions on its surface; its colour approaches that of gold; its pulp is pure white, of the consistence of that of the water-melon, and very saccharine. The fruit should remain on the plant till it be completely matured; for it improves in flavour and sweetness till it become soft and be ready to decay.—The *Valentia Melon* is produced plentifully in the countries bordering on the Mediterranean. It is remarkable for the property of keeping for many weeks; insomuch that it has sometimes been imported into London from Spain. In this country it is raised in the manner of other melons. The fruit gathered, when nearly ripe, and suspended in a dry airy room, will keep till January or February. Hence it is often called the Winter Melon. It is oval-shaped, and somewhat pointed at the ends; the skin thin, and of a dark green colour; the pulp whitish, firm, saccharine, and juicy: though the flavour is not rich, it is pleasant to the taste. Salonica Melon. Valentia Melon.

Succada.

A small green gourd has for some years past been cultivated in the neighbourhood of London, under the name of Succada or Vegetable Marrow. It may be raised in the spring on a common melon or cucumber hot-bed; and in June transplanted to the open border, in a good aspect, and trained to a small temporary trellis. When the fruit is of the size of a hen's egg, it is accounted fit for use. It is dressed in salt and water, squeezed, and served up in slices on a toast. Succada.

Mushrooms.

The usual mode of raising mushrooms, as well as of preparing the spawn, has already been described Mushrooms.

Kitchen Garden.

Oldaker's Method.

(*Encyclopædia*, Vol. IX. p. 443). But what is called *Oldaker's method* may deserve to be particularized. In forming the compost, he procures fresh short dung, from a stable, or from the path of a horse-mill. The dung must neither have been exposed to wetness, nor subjected to fermentation. There is added about a fifth part of sheep's droppings, or of the cleanings of a cow-house, or of a mixture of both. The whole ingredients are to be thoroughly mixed and incorporated. The beds, if they may be so called, are formed in coarse wooden boxes or drawers. A stratum of the prepared mixture about three inches thick, being deposited in the box, is beat together with a flat wooden mallet. Another layer is added, and beat together as before; and this is repeated till the beds be rather more than half a foot thick, and very compact. The boxes are then placed in the mushroom house, or in any out-house, where a slight increase of temperature can be commanded. A degree of fermentation generally soon takes place in the mass; but if heat be not soon perceptible, another layer must still be added, till sufficient action be excited. When the beds are milk warm (or between 80° and 90° Fahr.), some holes are dibbled in the mass, about nine inches apart, for receiving the mushroom spawn, which, it is to be presumed, has been previously prepared. The holes are left open for some time; and when the heat is on the decline, but before it be quite gone, a piece of spawn is thrust into each opening, and the holes are closed with a little of the compost. A week afterwards, the beds are covered with a coating, an inch and a half thick, of rich mould, mixed with about a fifth part of horse droppings. This is beat down with the back of a spade, and the bed may then be accounted ready for producing. The apartment is now kept as nearly and equally at 55° Fahr. as circumstances will allow. When the boxes become very dry, it is occasionally found necessary to sprinkle over them a little soft water, but this must be done sparingly, and with great circumspection. The more that free air can be admitted, the flavour of the mushrooms is found to be the better; but the exclusion of frost is indispensable. If a number of boxes or drawers be at first prepared, a few only at a time may be covered with mould, and brought into bearing; the rest being covered and cropped in succession, as mushrooms may happen to be in demand. In this way, they may be procured at every season of the year.

Preserving of Cauliflower during Winter.

Preserving of Cauliflower.

It is found that this vegetable may be kept in perfection over winter by very simple means. Cauliflowers which have been planted out in July, will be nearly ready for use in October. Towards the end of that month, the most compact and best shaped are selected, and lifted carefully with the spade, keeping a ball of earth attached to the roots. Where there are peach-houses or vineries, the plants are arranged in the borders of these, closely together, but without touching. Some of the large outside leaves are removed, in order that the plants may occupy less room, and at the same time any points of leaves that immediately overhang the flower (or eatable part) are cut off. Such houses, however, are generally kept not only without fire-heat, but as cold as possible, during the first part of winter: in time of frost, therefore, it is necessary to cover the cauliflower plants with mats and straw. Another mode consists in placing the cauliflower plants, raised with balls of earth as before, in hot-bed frames, as closely together as possible, without touching. In mild dry weather, the glass-frames are drawn off; but they are kept carefully closed during rain; and when severe frost occurs, they are thickly covered with mats. If the plants be occasionally cleared of decayed leaves, they will continue, in this way, in excellent state for several months, instead of becoming yellow and ill-flavoured, as they generally do when placed in sheds or cellars, where air and light cannot occasionally be given.

Keeping of Vegetables, &c. in the Ice-house.

Ice-house.

The *Ice-house* is generally under the care of the gardener; and where it is placed near the garden, it is found useful for several subsidiary purposes, and particularly for preserving esculent roots, and likewise celery, during winter, in recesses contrived for the purpose. Where parsnips and beet-roots are left in the ground over winter, they must be lifted at the approach of spring, as they become tough and woody whenever there is a tendency to form a flower-stalk. These roots may, therefore, at this season, be placed in the ice-house, and preserved there for a considerable time in excellent order. The ice-house is equally useful in this respect during the summer season: in hot weather, various kinds of vegetables, for instance green peas and kidney beans, can be kept fresh in it for several days.—In order to avoid introducing the subject again, another use may here be mentioned: fruits gathered in the morning, which is the most proper time for gathering them, are here kept cool, and with all their freshness and flavour, until required for the dessert in the afternoon. Several ice-houses, excellently adapted not only for the main purpose, but for these secondary views, which nowise interfere with the other, have lately been constructed in the neighbourhood of Edinburgh, under the directions of Mr Hay, planner of gardens, particularly at Dalmeny Park and Dundas Castle. These ice-houses have double walls, a passage being left between the outer and inner. In the thick wall immediately inclosing the ice are four recesses, with stone shelves for receiving the vegetables or fruits. In the outer wall the same object is provided for. The roof, it may be added, is arched with stone, and has a hole at the top for introducing the ice. The passage between the two walls is likewise arched, and has two or three small grated apertures, which may be closed with fitted stones, or opened for the purpose of admitting light and air when wanted.

FRUIT GARDEN.

Fruit Garden.

During the last thirty years the desire for fruit has greatly increased among the inhabitants of this country, and the attention paid to its production has advanced in proportion. The general diffusion of this taste has created such a demand in the me-

Fruit Garden.

tropolis and principal towns, that not only are professional cultivators enabled to lay out considerable capitals with advantage in the raising of exotic fruits, but great encouragement is thus given to private gentlemen to improve and enlarge their gardens, vineries, and peach-houses; because a ready and lucrative market is open for the superfluous produce at any time, and for the whole produce of the garden, when the proprietor and his family happen to be from home.—We shall first advert to any changes or improvements in the general management of the garden, or of the different kinds of hot-houses connected with it; and shall next take particular notice of the new fruits, or new varieties, which have been lately introduced, or have lately risen into notice.

Fruit-Trees in the Nursery.

Grafting with Matured Cions.

Some kinds of fruit-trees, particularly the Mulberry and Walnut, are so slow in their progress to a bearing state, that the planter of the trees seldom sees their fruit. Mr Knight has ascertained that, if the cions be taken from prolific branches of bearing trees, the young trees become productive in a very few years. Indeed, if the stocks be planted in pots, and grafted by approach, they afford fruit in three years after the operation. Young trees thus grafted with cions from the bearing wood of adult trees, are not yet to be found in the public nurseries; even the most eminent of our nurserymen not possessing a collection of bearing trees for this purpose.

Training of Young Trees.

In regard to the training of young trees, especially of the peach and pear kinds, notice may be taken of an excellent and simple mode for which we are indebted to Mr Knight. His plants are headed down as usual, a year after being grafted; two shoots only are allowed to each stem, and these are trained to an elevation of about 5°. It is a well known fact in horticulture, that a branch trained upright grows much more luxuriantly than one confined to a horizontal position. Advantage is here taken of this law of vegetation, and in order to procure the shoots to be of equal length, the stronger is depressed and the weaker elevated. All lateral shoots are carefully removed. Next season as many branches are encouraged as can be laid in without overshading each other; and if care be taken in the spring to select the strongest and earliest buds near the termination of the year-old branches, to be trained lowest, and the weakest and latest buds near the base of the branches to be trained inclining upwards, the result is, that, at the end of the season, each annual shoot comes to be nearly of equal vigour. In the following winter, one half of the shoots are shortened, and the other half left at full length, one shoot being left and the other cut alternately. In the third year, if the subject be a peach-tree, the central part will consist of bearing wood. The size and general health, and equality of vigour in every part, of young trees trained according to these rules, appear to evince a very regular distribution of the sap; and the rules are simple, and might easily be attended to.

Wall Training.

Wall Training.

As the trees above described advance, they naturally fall to be trained in what is called the *fan mode*, or according to various modifications of this. Where the garden-walls exceed seven feet in height, this is the mode now preferred by the best practical gardeners; for in this way a tree can much sooner be made to fill the space of wall allotted to it, and the loss of a branch can most easily be supplied at any time. The fan mode is particularly well adapted for such kinds of fruit-trees as do not abound in superfluous wood, or extend their branches to a great length, as the peach, nectarine, apricot, and cherry trees. For walls under seven feet in height, the *horizontal method* of training is still preferred, as in this way the wall can be more completely filled, although not in so short a space of time. In this mode, which was first strongly recommended by Hitt in his excellent *Treatise on Fruit-Trees*, a principal stem is trained upright, and branches are led from it horizontally on either side. Many kinds of pear-trees, and also apple-trees, are very productive when trained in this horizontal manner.

Bending of the Extremities.

In both modes of training, and with all kinds of trees, it has been found very advantageous to have the extreme branches bent downwards. By this means a check seems to be given to the growth of the wood of the tree, and a tendency to yield fruit is promoted. Besides, it is evident, that, in the flexure of the extremities of wall-trees, the natural mode of growth is imitated.

Connected with this subject is the recent practice of turning the extreme branches of fruit-trees from one side of a wall to the other. The late Sir Joseph Banks having a Gansel's bergamot pear-tree on a north aspect, where the fruit did not succeed, caused some branches be turned over to the south side, and trained downwards. There they not only produced fine fruit, but abundance of it. The roots of the May-duke cherry, and some others, require to be in a cool soil. On the north side of a wall, therefore, such trees thrive best; and it has been found, that if their extreme branches be turned over the wall, and trained downwards on the south side, they are not only brought into plentiful bearing, but yield their fruit more early in the season.

Protecting of Blossom.

Before leaving wall-trees, we may here notice, that, for protecting the blossom of peaches and nectarines from the effects of hoar-frosts and cold dews, nets made of coarse woollen yarn or carpet worsted have, in some parts of Scotland, been very advantageously employed. When such nets are worked in the loom, they can be afforded at a very cheap rate. They are woven pretty close, the meshes not being larger than to admit the point of the finger. Worsted nets are better than any other, on account of the bristliness of the material and its tendency to contract. Screens covered with white paper have likewise been employed with good effect. Where such screens are made to project sufficiently from the wall, and are applied in the evenings, they will be found very effectual in preventing the radiation of heat from the earth in the cold and clear nights

Fruit Garden.

which often follow warm days in May and June; and not the setting fruit only, but tender plants, such as love-apple, may thus be protected. The importance of this remark will be evident to all who have attended to the doctrines of Dr Wells and Professor Leslie on the subject.

Fruit-Trees in the Pyramidal Form.

Standard fruit-trees, particularly pears, are now frequently trained in a pyramidal form, or what the French term *en quenouille*. This is effected by preserving only an upright leader, and cutting in the lateral branches every year. Trees managed in this manner occupy much less room, and throw much less shade, than when allowed to spread their branches at will. If thought proper, they may likewise be planted very near together without injury; six or at most eight feet being a sufficient space between such trees. In general these pyramidal trees are very productive. They are not well calculated, however, for places subject to high winds, but rather require a sheltered situation. In appearance they are stiffly symmetrical, and the lover of the picturesque in gardening, would greatly prefer the natural spreading of the tree.

Dwarfish.

Apple-trees are now very generally trained *en buisson*, or as dwarfish standards, and in this form they can be scattered along the borders of the garden without producing inconvenience.

Frequent Grafting.

Particular varieties of apple are observed to succeed in certain soils and situations better than in others: it is the business of the cultivator to take notice of these, and to multiply them by grafting. At the garden at Dalkeith belonging to the Duke of Buccleuch, where the soil is shallow and the subsoil unfavourable, great crops of apples are yearly produced, merely in consequence of planting shallow and of frequent grafting. Mr Macdonald, the excellent gardener officiating there, annually inserts on his numerous trees not fewer than from 2000 to 3000 grafts, generally three or four sorts on each tree. The grafts are chiefly of such kinds as experience has taught him to prove generally successful at Dalkeith garden.

Decorticating.

Barking of Fruit-trees.

When the outer bark of fruit-trees, especially of the apple kind, becomes rough and cracked, so as to admit minute insects to deposit their ova under it, it has for a long time been the practice to remove it entirely, and to cleanse the trunk and principal branches with some kind of wash. This partial decortication and cleansing, it was observed, not only produced a healthy foliage, but had an evident effect in promoting the fruitfulness of the trees, or in causing the conversion of leaf-buds into flower-buds. Of late years, Mr Lyon of Edinburgh, founding wholly on his own experience, has particularly called the attention of the public to the practice of decortication; and he has invented several simple instruments for facilitating the removal of the bark. He has carried the practice much farther than his predecessors, who, as already noticed, removed the bark only when it was somewhat diseased, and only from the trunk and larger branches. Mr Lyon recommends the stripping even of young trees, and of the new shoots of full grown trees, however healthy the bark may be. Even where the bark of a tree is healthy, a partial removal of it (as in the practice called *ringing*, presently to be noticed) may prove beneficial, in causing the production of fruit-buds; but it is evident that a useful practice may be pushed too far.

Barking of Vines.

The decortication of vines has likewise been revived, and has been strongly recommended of late, in a pamphlet by Sir John Sinclair, who founds particularly on the experience of Mr King, an active and industrious fruit-gardener at Teddington in Middlesex. The operation is performed in the beginning of winter, with a common knife; for the outer bark may, at that season, be easily separated from the inner concentric layer, without hurting the latter. Not only are the plants thus treated freed from numerous small insects, which never fail to make a lodgement in the crevices of the rough parenchymatous bark, but they are observed to make stronger shoots, and the quantity of grapes is said to be increased, and their quality improved.

Ringing of Vines, &c.

Analogous to this is the practice of *ringing* of the branches of vines, or making a narrow annular incision, and removing a ring of the bark: in this case, both the outer and the inner bark is removed. The consequences of this practice are said to be very beneficial. The same plan of removing a ring of bark, about a quarter of an inch in breadth, and down to the alburnum, has been practised on apple and pear trees, by different cultivators, with considerable success; the trees being thereby not only rendered productive, but the quality of the fruit being at the same time apparently improved. The advantage is considered as depending on the obstruction given to the descent of the sap, it being thus more copiously afforded for the supply of the buds. The ring should therefore be made in the spring; and it should be sufficiently wide, that the bark may remain separated for the season in which it is made. None of the stoned fruit trees are benefited by ringing.

Pruning of Currant Bushes.

Currant Bushes.

An improvement in the management of the currant-tree deserves notice. Mr Macdonald at Dalkeith, whose name has just been mentioned, prunes the bushes at the usual season of midsummer, shortening the year's shoots down to an inch or an inch and a half. Next summer the plants generally show plenty of fruit, and at the same time send out strong shoots. As soon as the berries begin to colour, he cuts off the summer shoots to within five or six inches before the fruit. For the sake of expedition, this operation is commonly performed with the garden shears. Sun and air thus get free access to the fruit, and more of the vigour of the plant is directed to it: in consequence, the berries are found to be not only of higher flavour, but of larger size.

Hot-houses.

Pine-Stoves.

All the different kinds of glazed houses employed for the production of the more tender exotic fruits, have in some respects received improvements. But *pine-stoves* have undergone the greatest change

of structure. In place of the lofty wide houses of former times, small low pits are now employed. These are commonly of two sizes; one, called the Succession pit, is rather lower in the roof and of smaller dimension than the other, which is the Fruiting pit. The advantages are considerable: the atmosphere of these last can much more easily be maintained at the requisite temperature; and the plants enjoy the advantage, well known from experience, of being placed near to the glass. In propagating ananas, some of the most successful cultivators use suckers only: these are allowed to remain long on the parent plants, so that when they come to be detached they are of a larger size and more forward growth than is usual. The suckers are planted in pots in September, and placed in beds of tan, in any common hot-house furnished with a furnace and flues. After the plants have fairly made roots, a high temperature is not wanted, and, for the following six months, if frost be carefully excluded, the plants succeed best in a cool house, which may be supposed somewhat to resemble the winter of their native country: pretty late in the spring, they are transferred to the pine-pits. Sometimes this is in reality little else than a large hot-bed having tanners' bark in the centre, and being furnished with exterior linings of stable litter, or some other fermentable material. In other cases the pit has likewise a furnace and flues: in those pits, however, which depend on fermentation alone for artificial heat, the ananas are observed to grow remarkably fast during the summer season. In autumn the plants are again returned to the common hot-house for the winter: in the course of the following season they are brought to fruit in the larger sized pit; and if this be not of sufficient dimensions, as sometimes happens from the spreading of the plants, a few of the most forward are allowed to fruit in their winter quarters. In this way pine-apples, particularly of the variety called the Queen, are produced in two years, instead of three, which were formerly thought necessary.

In the opinion of Mr Knight and of other eminent cultivators, the employment of a bark-bed, or bottom heat of any kind, is wholly unnecessary after the crowns or suckers have pushed their roots. In an ordinary hot-house, the pots may be placed on loose piers of brick, and thus raised near to the glass; a layer of bricks being removed as the plants increase in height. In the summer season, the temperature may depend chiefly on confined solar heat, no air being given till the temperature exceed 95° Fahr. For soil Mr Knight prefers thin green turf chopped small, and pressed close into the pots while damp; a piece of whole turf, with the sward downmost, being laid at the bottom of the pots. The surface, however, is covered with vegetable mould and sandy loam mixed. Mr Knight recommends applying daily to the pots, during the height of summer, water in which pigeons' dung has been steeped till the colour be nearly as dark as that of porter. A little pure water may be sprinkled over the plants, but this is not to be repeated till all remains of the former sprinkling have disappeared. As the day gets shorter, less of the pigeons' dung water is given, the plants being then less able to feed on it. During winter the house is kept as nearly as possible at 50° Fahr. Mr Knight prefers pots which are little more than a foot in diameter, and he does not seem to consider repotting as necessary: at least, he regards the shifting from smaller to larger pots as detrimental, the matter which would go to the formation of blossom and fruit being thus diverted to the production of new roots.

It may here be remarked, that for communicating heat to pits or frames, it has been found advantageous, in place of stable litter, to employ the cleanings of a flax-dresser's mill, known under the name of Lint-shows or Flax-pob. This substance ferments very slowly, and the heat is therefore kept up for several months in succession, and very nearly of an equal temperature.

Various improvements and changes in the form and interior arrangements of glazed houses intended for the production of peaches, nectarines, figs, and grapes, have of late been introduced or recommended. These are detailed chiefly in the *Transactions of the Horticultural Society of London*, and in the *Memoirs of the Caledonian Horticultural Society*. Mr Knight and Mr Gowen, with Mr Loudon at Bayswater near London, seem to be the principal persons who have attended to these subjects in England; and Mr Hay of Edinburgh, Mr Beattie at Scoon, and Mr Henderson at Brechin, have led the way in Scotland. Among amateur horticulturists, our countryman Sir George Mackenzie has distinguished himself by projecting spherical hot-houses; and modifications of this form have been strongly recommended by Mr Loudon.

Glazing of Hot-houses.

A very considerable improvement in the mode of glazing hot-houses may deserve to be more particularly mentioned, because it tends materially to obviate breakage, which, on account of the high duty on glass in this country, is now an important object. It consists chiefly in making the upper and lower edges of the panes segments of a circle, instead of being rectilinear or horizontal; the upper edge being made concave, the lower convex. For a pane eight inches wide, a curvature $\frac{5}{8}$ths of an inch deep in the centre is sufficient. The advantages of this circular form must be evident. The rain which falls, or moisture which collects on the exterior of the glass, gravitates to the centre of the pane, and runs down in a continued line, instead of passing along the sides of the bars, and being partly detained by the capillary attraction of the two surfaces, at the overlapping of the panes. The extent to which one pane overlaps another can, at the same time, therefore, be much lessened; and $\frac{1}{8}$th of an inch is found sufficient. This narrowness of the lap, again, prevents breakage from the lodging of moisture, and the sudden expansion produced by freezing during the variable weather of winter. When these circular panes are cut from whole sheets of glass, the expence is scarcely greater than for oblong squares. It is proper that the glass should be very flat or equal; and the kind known by the name of Patent Crown Glass should be preferred. In stoves or hot-houses where a high temperature must be maintained, the laps are puttied. In this case, a small central opening is left in the

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putty, by inserting a slip of wood at first, and withdrawing it when the pane is pressed down to its bearing; by this little aperture the condensed vapour generated within escapes without dropping on the plants. The ingenious Mr Loudon uses very thin sheet lead in place of putty, for closing the laps; he thus avoids all risk of expansion from frost, and the lap can thus be made exceedingly narrow.

Heating of Hot-houses by Steam.

Steam Hot-houses.

Of all recent improvements, however, in this branch of gardening, the most important is the use of *steam* for communicating the artificial heat, in place of depending, as formerly, on the passage of smoke and heated air through flues, aided in particular houses, called Stoves, by the slight fermentation of tanners' bark. The principal advantage arising from the use of steam consists in this, that an equable high temperature can thus be maintained for a length of time with much greater ease and certainty. Besides, in steam hot-houses, the plants can scarcely ever be liable to suffer a scorching heat; the air continues pure and untainted, and persons visiting the house are much less apt to be annoyed with the smell of smoke or soot. In districts where coals are scarce and high priced, the saving of fuel is an object; and it has been found that seven bushels of coal go as far in keeping up steam heat, as ten bushels do in maintaining an equal temperature the other way. Further, it is evident that, by merely opening a valve, the house may, at any time, be most effectually *steamed*, that is, filled with vapour; and the warm moisture thus applied to every part of the plants is observed to contribute remarkably to their health and vigour.

While steam alone may, in new erections, be trusted to for supplying the necessary heat, it fortunately so happens that it may likewise very advantageously be resorted to *in aid* of the common flues conveying smoke and heated air. A steam-apparatus may be appended to any ordinary hot-house, without incurring any material expence, or occasioning any considerable alteration in structure. A boiler is erected over the usual furnace, the smoke of which passes through the flues as formerly. Metal pipes are laid along the top of the brick-flues. These are rather of copper than of lead, on account of the former expanding less. A square shape is sometimes preferred; and the pipes are set on edge, so that any condensed vapour trickling to the bottom may occupy little room, or present only a small surface, till it make its way back to the boiler, to which a gentle inclination is given. As in the common steam-engine, the boiler is supplied from a cistern above, and is made to regulate itself by a simple contrivance; in the feed-head is a valve, which is opened by the sinking of a float, which descends in proportion as the water is dissipated in steam; and being balanced by a weight, whenever a sufficient quantity of water is admitted, rises again and shuts the valve. A safety-valve is added, loaded according to the strength of the boiler; and there is another valve for admitting atmospheric air, in case of the condensation of the steam causing a vacuum in the boiler. By thus adding a steam-apparatus in aid of the common flues, a higher and much more steady heat can be commanded. Instead of requiring more of the time and attention of the gardener, he will be greatly relieved, and have several additional hours a day which he may wholly devote to other concerns of the garden. If the furnace be duly charged, and the boiler properly prepared, the hot-house may be left with confidence for eight or even ten hours together, the temperature continuing equal for that length of time. Where forcing is practised during the severe weather of winter and early spring, the gardener is thus relieved from much anxiety and night-watching, to which he was formerly subject.

For heating stoves, conservatories, and green-houses, steam is likewise excellently adapted. The difficulty of maintaining continually a high temperature in a large stove has, no doubt, been one cause of the comparative neglect into which the cultivation of fine tropical plants in England has fallen. By means of steam, this difficulty is most effectually removed: and we may soon expect to see the noble palms and arborescent ferns of the tropical regions, waving at large in commodious receptacles heated in this manner.

It may here be mentioned, that the cultivation of tender exotics has of late been further rendered easy, by the substitution of a chamber filled with heated air, or with steam, in place of tanners' bark; the procuring of which is often attended with difficulty and expence, and the proper drying of it invariably troublesome. The plants are placed immediately over the steam-chamber, the roof being formed of thin flagstones, like those known by the name of *Arbroath pavement*. The pots may be sunk in sawings of wood, which remain for a very long time in a clean and unaltered state; and in which insects are not very apt to breed.

For the conservatory and green-house, if the steam be in action from three to nine o'clock P.M. the temperature will be kept constantly within a proper range, in the ordinary winter weather of this country. In time of severe frost, the steam must, of course, be longer applied.

Steam Hot-houses at Hackney.

The most extensive and most perfect steam-apparatus for the heating of plant-houses is to be seen at the grounds of Messrs Loddiges, near Hackney, where glazed houses to the extent of almost a thousand feet in length, and forming three sides of a square, are heated solely by steam from a single boiler. The boiler is of an oblong shape, measuring eleven feet by four, and is made of malleable iron. In certain narrow houses, intended for green-house plants, a single steam-pipe is found sufficient. In other houses, of considerable height and breadth, or where a higher temperature is required, as in the palm-house, the steam-flue is made to describe two or three turns. The pipes at Hackney are of iron, of a round shape, and four inches bore. They are flanched and screwed together with bolts and nuts. When they make returns within the house, the joints are formed with iron cement on milboard dipt in white lead.

Where steam is employed for heating the principal suite of hot-houses, it will be found easy, in general, to convey it also to the melon ground; the

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melon pits or frames must, however, in this case, have their side-walls formed of brick. In places where steam-heat has been applied to the culture of this fruit, the success is said to be remarkably great.

Watering of Green-house and Hot-house Plants.

Watering of Hot-houses.

When large collections of plants are kept in the green-house, hot-house, or conservatory, the watering of them by the hand is a tedious operation. Messrs Loddiges, already mentioned, have devised a mode of greatly facilitating this operation. A leaden pipe, of half an inch bore, is conducted horizontally along the upper part of the house, in the space most convenient for the purpose in view. This pipe is everywhere perforated, the holes being so small as only to admit a fine needle. The perforations are so disposed in the pipe as to throw the water in the directions where it is most wanted. In general, the holes are at two inches distance from each other; but, towards the extremity of the pipe, where the pressure of the water is less, they are somewhat closer. The cistern must, of course, be above the level of the pipe. By turning a stop-cock, the water passes along the pipe, and is diffused over the plants, in the manner of a gentle shower of rain.

Production of new Seedling Fruits.

Mr Knight's Doctrines.

During the last twenty years great attention has been paid to the production of new seedling varieties of the more hardy fruits suited to our climate. For exciting the attention of the public to this important matter, we are particularly indebted to Mr Knight. A very succinct statement of his views on this subject, which have sometimes been strangely misrepresented and even turned into ridicule, may here be proper. In his *Treatise on the Apple and Pear*, he noticed in a particular manner the fact, that some of the finest cider and perry fruits of the seventeenth century have already become extinct. This fact was undeniable; for daily experience showed, that the golden pippin in England, the grey Leadington and white Hawthorndean in Scotland, and other old apples, were fast wearing out. Mr Knight remarked, that each variety of fruit springs from an individual at first; and that, by means of grafting or budding, the individual only has been extended. Whatever tendency to decay and extinction existed in the individual at first, must, he observed, exist in all the extensions of that individual accomplished by means of buds or grafts. By careful management or fortunate situation, the health and life of a particular individual or original tree may be prolonged; and, in like manner, some buds or grafts, placed on vigorous stocks and nursed in favourable situations, may long survive other buds or grafts from the same tree, or may long survive the original unengrafted tree. Still, in all of them, there is a progress to extinction; the same inevitable fate awaits them: the only renewal of an individual, the only true reproduction, is by seed.

Mr Knight's doctrine, we may add, seems now to be established as to fruit-trees. It may probably be extended to all trees, and even to all the more perfect tribes of plants; for the sagacious Philip Miller long ago observed, that herbaceous plants propagated by *cuttings*, became barren in a few years. The importance of acquiring new varieties of our staple fruits from the seed is now, therefore, universally acknowledged; and as a taste for experimenting in this way is prevalent, we may probably do an acceptable service to our readers, in bringing together some of the precautions adopted by the distinguished horticulturist already so often mentioned, and the facilities which have been devised towards success in this interesting branch of gardening.

Raising of new Varieties of Fruit.

The seeds to be sown should belong to the finest kinds of fruit, and should be taken from the ripest, largest, and best flavoured specimens of each kind; for although some crab-apples may result from sowing the seeds of the nonpareil or the Newtown pippin, yet from the seeds of such excellent varieties, there is a greater chance of procuring an apple somewhat similar in qualities. Mr Knight took uncommon pains in order to procure promising seeds: for example, he prepared stocks of the best kinds of apple capable of being propagated by cuttings, and planted these stocks against a wall in a rich soil; these were next year grafted with the golden pippin. In the course of the following winter, the young trees were raised from the ground, and the roots being shortened, they were replanted in the same spot. By this mode of treatment they were brought into a bearing state at the end of two seasons. Only two apples were suffered to remain on each little tree; these fruit consequently attained a large size and perfect maturity. The seeds of the apples thus procured were sown, in the hopes of procuring seedlings possessed of qualities allied to those of the golden pippin; and if these hopes have not yet been fully realized, the success has been sufficient, at least, to encourage to perseverance in similar modes of experimenting.

It may here be mentioned further, that, with the view of producing a variety uniting the good properties of two known and highly approved kinds, Mr Knight, Mr Macdonald, and some others, have been at the pains to bring the pollen of the one kind in contact with the pistils of the other. To do this with proper effect, requires some nicety and caution. Mr Knight opened the unexpanded blossom of the variety destined to be the female parent of the expected progeny, and with a pair of small-pointed scissors cut away all the stamina while the anthers were yet unripe, taking great care to leave the style and stigmata uninjured. The full blown blossoms of the other variety were afterwards applied. The fruits resulting from such artificial impregnation have been of the most promising character: the seeds of these fruits, again, were sown, with the expectation of procuring improved varieties, and there is every reason to think that the expectation will be realized. Mr Knight has often remarked in the progeny, a strong prevalence of the constitution and habits of the female parent: in this country, therefore, in experimenting on pears, the pollen of the more delicate French kinds, as the crasanne, colmar, or chaumontelle, should be dusted upon the flowers (always deprived of stamina) of the muirfowl egg, the grey achan, the green yair, or others that

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are hardy or of British origin. By these means, it may be hoped that, in the course of another generation, excellent *winter* pears may be obtained in abundance from our standard trees; for at present we are nearly destitute of hardy winter pears.

Some persons make a practice of sowing great numbers of seeds, taken indiscriminately. Out of some hundreds of such seedlings, a very few only may prove deserving of any notice. In the ordinary course of nature, the lapse of six or perhaps ten years would be required before the fruit could be seen. But in order to form a general estimate of the character of the seedling trees, it is not necessary to wait till they actually produce fruit: even in the first season, such an opinion may, to some extent, be formed, from the shape and texture of the leaves; those which are pointed, thin and smooth, promising little; while those which are blunt or round, thick, and inclined to be downy, promise well. In the second year, these tests are more satisfactory; for the leaves of good kinds improve in the above noticed qualities yearly. Plants whose buds in the new wood are full and prominent, are much to be preferred to those whose buds are small and almost sunk into the bark.

Some means have likewise been devised for hastening the production of the fruit of seedling trees, or shortening the period of probation. The moving of the plants and shortening of their roots have already been mentioned. Mr Williams of Pitmaston, an eminent English horticulturist, has succeeded in promoting their early puberty, by using means to hasten that peculiar organization of the leaf which appears necessary to the formation of blossom-buds. The seeds (of course only of select kinds) are sown in pots, and the growth of the seedling plants is forwarded by the artificial heat of a peach-house or vinery. They are afterwards planted out in nursery lines. Every winter, all small trifling lateral shoots are removed, leaving the stronger laterals at full length; and such a general disposition of the branches is effected, that the leaves of the upper shoots do not shade those below. Every leaf, by its full exposure to light, is thus rendered an efficient organ, and much sooner becomes capable of forming its first blossom-bud. Those who have even slightly studied vegetable physiology, must be convinced of the great consequence of attending to such apparently minute circumstances.—Another plan resorted to with success, consists in taking cions from the seedling trees, and grafting them on wall-trees in full bearing: in this way, the fruit may be seen in three or four years from the sowing of the seeds. If it possesses any promising qualities, such as fine colour, firmness, or flavour, it ought not to be rejected at first on account of acidity or smallness of size: If a seedling be somewhat juicy, it is very promising, for this good quality also increases with its years; and it is remarked, that a fruit having a firm pulp commonly improves with the age of the tree, but that a soft or mealy pulp gets worse. In general it may be remarked, that the fruit has always a tendency to improve in mellowness and in size, as the tree itself becomes stronger and approaches maturity.

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Not only have British horticulturists been successfully occupied in producing new varieties at home, but they have at the same time been extremely active in introducing approved kinds raised in other countries. Some of the best new varieties, both native and foreign, of the different fruits usually cultivated, shall now be enumerated.

New Varieties of Fruits.

New varieties already produced. Apples.

Apples.—For the best new varieties of this excellent and useful fruit, we are indebted to Mr Knight. The *Downton Pippin* has now been known and approved of for a good many years. In exposed or upland situations, it comes of better quality than in low and warm places. The *Wormsley Pippin* is a large fine fruit, resembling in the consistence and juiciness of its pulp the Newtown pippin. The *Yellow Ingestrie Pippin* is the produce of one of the hybrid fruits already mentioned, between the golden pippin and the orange pippin: in shape and colour it resembles the former, and it also rivals it in richness and flavour. The *Scotch Nonpareil* is another of the hybrid productions, for which we are indebted to Mr Macdonald of Dalkeith. It was raised from a fruit produced after dusting the blossoms of the nonpareil with those of the Newtown pippin. By grafting on a wall-tree, he procured the new fruit in the fourth year. Specimens of this fruit have at different times been exhibited at meetings of the *Caledonian Horticultural Society*, and have always met with great approbation. The *Russet Nonpareil* was raised at Pitmaston near Worcester, from seed of the nonpareil. The blossom appears to be more hardy than that of the parent variety; the fruit is compressed, of a dull green, much covered with russet; the pulp is of a pleasant consistence, and highly charged with the peculiar aromatic flavour which characterizes the nonpareil. The *Martin Nonpareil*, raised likewise near Worcester, is regarded as a fine dessert fruit; it is remarkable for keeping in a sound state, not only over winter, but till the following midsummer; for supplying the table, therefore, in the spring months, this variety is valuable. Still another offspring of the nonpareil has been recommended in the *Transactions of the London Horticultural Society*, called the *Braddick Nonpareil*; the pulp is sweeter and more melting than that of the nonpareil, richly sugared, and slightly aromatic. The *Breedon Pippin* is a new English variety which cannot be traced to its original: in shape it is flatly conical, with many plaits or wrinkles around the eye; the skin is of a deep dull yellow; the pulp yellowish, firm, very sweet, with a rich vinous acid. The *Lamb Abbey Pearmain* is the offspring of an imported Newtown pippin; but it differs very much in shape and general appearance from the Long Island fruit, being of an oval form and somewhat pyramidal; the pulp is yellowish next the skin, and green next the core, very firm, so as to fit for keeping, at the same time juicy, richly sweet, and not without flavour: the tree requires to be trained against a wall or espalier rail, because the branches are so slender that they cannot, in general, support the fruit.

From North America we have, of late years, re-

ceived several excellent varieties of apple. The *Newtown Pippin* from Long Island, already repeatedly named, deserves the first place. It is an excellent dessert apple, allied to the rennets; it keeps well, is in perfection for the table in January, but continues good till March or later. In this country the tree requires a wall with a good aspect. The *Spitsenberg Apple* is of a fine appearance, and the pulp has somewhat of the pine-apple flavour: the tree requires a sheltered situation and good soil; it succeeds better on a west than an east wall. The *American Nonpareil* or *pomme de grise* is a high-flavoured apple, introduced only a few years ago; it ripens very well on a wall having a west aspect. The *Canadian Rennet* is a large fruit, of a yellow colour, with a tinge of red; it likewise requires a wall in this country. Of varieties brought over from the Continent, we shall only notice the *Borsdorfer*, which is one of the most highly esteemed throughout Germany. The fruit is round, of a yellow colour, but red next the sun; having a rich flavour, it is suited to the dessert, as well as for all culinary purposes.

Pears.

PEARS.—For the production of new seedling pears in this country, longer time and more attention are required than in the case of apples. Generally ten or twelve years elapse, before a seedling pear-tree shows blossom-buds. Only two new pears can here be recommended; but several very promising seedlings are known to be in a state of progress both in England and Scotland.—The *Wormsley Bergamot* has been raised by Mr Knight, from the blossom of the autumn bergamot dusted with the pollen of the St Germain. It is a melting pear, of good flavour. The tree grows freely, and the blossom appears to be hardy.—*Williams' Bon Chretien* is a large fruit, of a pale green colour; pulp white, very tender, abounding with an agreeably perfumed sweet juice. The tree bears freely, even as a standard; but the fruit comes to greatest perfection on a west wall. It is now a good deal cultivated in the neighbourhood of London.

From America, we have, of late, received an excellent variety, called the *Sickle Pear*. The fruit is rather small; sometimes of a yellow colour, and red next the sun, at other times altogether of a russet appearance; the pulp is melting, juicy, and of exquisite flavour. The tree is very vigorous and quite hardy.—The public nurseries at Edinburgh have, within these few years, been enriched with grafts of some of the finest seedling pear-trees raised at Brussels by Mr Van Mons, a distinguished cultivator there, and now Professor of Rural Economy at Louvain. None of them have yet produced their fruit in this country; but a Committee of the *Caledonian Horticultural Society* had an opportunity of tasting several of the fruits at Brussels, and have particularly recommended those called Poire Marie Louise, Poire Napoleon, Marly, Diel, Salisbury, Archduke Charles, and Callebasse.

Peaches.

PEACHES.—In the production of new peaches, Mr Knight again excels. He planted several peach-trees in large pots, and paid every attention to bringing them to a state of high health and vigour; he then applied to the pistil of one good kind the antheræ of another; each tree was allowed to bring to perfection no more than three fruits: from sowing the stones of these some new and improved seedling varieties were looked for, and the expectations have not been disappointed. Two new kinds deserve particular notice; and the situation of Downton, the seat of Mr Knight, being rather high and exposed, it may be presumed, that fruits which are produced there, may probably succeed even in the more northern parts of the island. 1. The *Acton Scott Peach.* The fruit comes early, and never fails to attain maturity; it is juicy and sweet, with a rich flavour. The tree is a plentiful bearer, and not liable to mildew. This new variety deserves the especial attention of Scottish horticulturists. 2. The *Spring Grove Peach* is of a bright yellow colour, and red next the sun: it has a firm but not hard pulp, which melts in the mouth, and has a remarkably rich, brisk, and vinous flavour. The fruit never becomes over-ripe or mealy, but, when quite ripe, is apt to shrivel a little: it is then in the most perfect state for the table. The tree grows slowly, but ripens its wood early in the season. It seems to succeed better on an apricot than a plum stock.

To America we owe *Braddick's American peach,* figured and recommended in the second volume of the *London Horticultural Transactions.* It is a large fruit, with a yellow skin, red next the sun; the pulp is yellow, and of high flavour. It is not a hardy kind, nor does the tree produce freely.

Nectarine.

NECTARINE.—We know only of one new variety of nectarine, which can at present be recommended for cultivation. This is the *Woodhall Nectarine*, so called from its having been raised at Woodhall, near Holyton in Scotland, by Mr Walter Henderson, gardener there, well known as a most successful cultivator of the Citrus and Erica tribes. The fruit approaches most nearly to the elruge; but it is more juicy, and perhaps also of a higher flavour; the fruit never fails to come forward to maturity. At present its good qualities are evidently on the increase. The tree grows freely, and has never shown the slightest symptom of mildew; the wood ripens readily in the autumn. The blossom is small, early, and hardy; and ever since the tree came into bearing, about six years ago, it has not once failed to produce an abundant crop.

Plums.

PLUMS.—The most important acquisition of the plum kind has been described and figured by Mr Hooker in the third volume of the *London Horticultural Transactions*, under the name of *Wilmot's New Early Orleans Plum.* In general habit the tree resembles the common Orleans; but the fruit ripens three weeks before that of the Orleans. Notwithstanding this early maturity of the fruit, the blossom is later of expanding than in almost any of the plum tribe. The combination of the properties of late flowering and of early ripening, must render this variety peculiarly valuable in the northern division of our island. The fruit resembles that of the Orleans, but is softer and more juicy, and of excellent flavour. The habit of the tree is vigorous and fertile.—*Coe's Golden Drop* is generally regarded as a new variety. The leaves of the tree are uncommonly large, and this is the most marked character of the variety. When the fruit is ripe, the pulp is of a gold yellow colour;

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on the side next the sun the skin is dotted with violet and crimson. The fruit may be kept for many weeks if suspended in a dry place. The tree requires a wall, but succeeds very well on a west aspect.

The *Hailes Plum* is a seedling of excellent qualities, which has lately been raised at Hailes, near Edinburgh, by Mr Clephane, gardener there. The foliage of the tree is remarkably light-coloured; the fruit is yellowish-white, juicy, and has a good deal of the rich flavour of the greengage.

Cherries.

Cherries.—To Mr Knight we are indebted for four new or seedling cherries, all of which are either good or highly promising.—1. The *Elton* is the production of a blossom of the graffion, to which the pollen of the white heart had been applied. This variety is distinguished by a deep tinge of crimson on the petals, and by the great length of the fruit-stalks. The pulp is very juicy, and has a delicate flavour.—2. The *Black Eagle* was from the graffion and the May-duke. Both tree and fruit bear a considerable resemblance to the May-duke.—3. The *Waterloo* (so named from the circumstance of the fruit having first ripened about the time of the celebrated battle) had the same origin. The fruit is somewhat later in ripening than the black eagle, and is rather larger and more conical at the point. It is nearly as hardy as the May-duke, and has been observed to attain tolerable perfection even in cloudy and rainy weather. When ripe, it is of a deep red colour, almost black.—4. The *Early Black* had also the same origin, and is nearly allied to the immediately preceding, from which it is most easily distinguished, by having a shorter fruit-stalk. It ripens fully a week before the May-duke, and is therefore one of the very earliest cherries. The pulp is soft and sweet, but not very juicy nor rich. As the original tree, however, is still very young, the fruit will in all probability improve in the qualities of juiciness and flavour.

Grapes.

Grapes.—For one of the best new grapes, the *Variegated Chasselas*, we are likewise indebted to the indefatigable Mr Knight. He procured it, by bringing the pollen of the Aleppo grape to a flower of the White Chasselas. The berries are striped and beautiful, have a thin skin, and are very juicy. The vine has been found to be very hardy, and constantly productive, bearing good crops on the open wall in England. The bunches gathered in October, and hung up in rather a damp room, may be kept till February or later.—The *Pitmaston White Cluster* was raised, as intimated in the name, by Mr Williams, who has already been mentioned as a very active and intelligent amateur horticulturist, in the West of England. It sprang from a seed of the Auverna, or small black cluster, the variety which is common on cottage-walls near London. The berry is round; when ripe, of an amber colour, bronzed with russet on the one side. The leaf is thin, and of a dark green colour. The vine is hardy, and a copious bearer. The berries are crowded, like those of the black cluster; but the bunches are larger, and ripen more early. It comes to perfection on the open wall in England. As it is early, and the berries are not apt to crack, it is well suited also for forcing.—The *Esperione* is not a new grape, but it has only of late come into particular notice. The vine is hardy, of luxuriant growth, and bears large crops: it perfects its fruit on the open wall near London, equally well as the sweet-water or white muscadine. Indeed, Mr Aiton, of the Royal Gardens at Windsor, mentions that, in unfavourable seasons, it has a decided advantage over these varieties, in being less retarded or affected by the state of the weather. It may, therefore, prove an acquisition in the northern parts of Britain. The bunches are large, and shouldered not unlike those of the black Hamburgh. The berries are of a fine dark colour, with a bluish farina; the pulp adheres to the skin; though neither highly flavoured nor melting, it is very pleasant.

Gooseberries.

Gooseberries.—Great attention has been paid, for a number of years past, to the raising of new and improved varieties of the *Gooseberry*. This being a branch of experimental horticulture fortunately within the reach of almost every man, it is pleasant to observe, that it has been practised especially by the cultivators of Lancashire, many of whom are workmen having small gardens for their recreation. For size, in particular, the gooseberries of Lancashire excel all others; insomuch that foreigners, at first sight, generally regard them as belonging to the plum tribe. To enumerate even the principal varieties seems unnecessary; numbers are constantly rising into some degree of notice, while others, of temporary celebrity, are losing ground. Among the red, the *old ironmonger*, the *red Champagne*, the *Warrington*, and the *captain*, are at present held in high esteem. *Wilmot's early red* likewise deserves particular mention: it is very early ripe, and of excellent flavour; in May, it is better for tarts and sauces than most others, being larger, and the skin not being tough, but melting down with the rest of the berry. The bush is easily cultivated, and is very productive.

Raspberries.

Raspberries.—Mr Williams of Pitmaston has lately raised from the seed a double-bearing red raspberry, the fruit of which is greatly superior to that of the old double-bearing variety. The second crop of this new kind begins in the end of August, and continues till the end of October. The autumnal fruit is produced not only at the ends of the annual shoots, but also on suckers, which rise from the root about midsummer, and bear abundantly.

Currants.

Currants.—Of the currant no variety superior to the *large Dutch white* and the *Champagne* has yet come into general notice. The latter is intermediate between red and white, and is larger and more juicy than the red. The *Pollock white* is an excellent variety, which has been raised from the seed, at the garden of Sir John Maxwell, Bart. by Mr Campbell, the gardener there, but which is not yet generally known. The property on which its excellence depends is superior sweetness. It may be remarked, that the importance of thus gaining from the seed more saccharine kinds has greatly increased, in consequence of the very general employment of the berries in the making of home made wines.

Strawberries.

Strawberries.—Of the strawberry several new varieties have lately appeared. Of these novelties, one originally raised by Messrs Caddenhead at Aberdeen, and called the *Roseberry Strawberry*, has acquired the highest character for excellence. In the

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berry it resembles the scarlet or Virginia, but it is larger, and of a richer flavour. The flower-stalk of the plant rises completely above the leaves; the produce is very great, and the fruit ripens in succession for several weeks, in this respect resembling the habit of the alpine strawberry. So prolific is this variety, that plants which have been forced in the early spring, and yielded a crop in the hot-house, afford, when turned out of the pots into the open border, a second crop in the summer. Nay, Mr Lee of Hammersmith repotted in the autumn some plants which had been forced in the spring; and, on being placed in a vinery, they produced ripe fruit in November and December, not only very fine in appearance, but excellent in flavour. The roseberry is now much cultivated, both for the Edinburgh and London market.—Mr Knight has raised, from the seed of the scarlet, a variety which is now called the *Downton Strawberry.* The fruit is large, but irregular in shape; the external colour a bright scarlet; the pulp soft, juicy, sweet, and of a rich flavour. The plants produce abundantly, and are hardy, the leaves remaining green through the winter.—A variety, called the *Mulberry Strawberry,* is likewise a good deal cultivated at Edinburgh. The berries make a fine appearance, being of a dark purplish red colour, and the acini of the fruit being large. They are not, however, desirable for the dessert, the firmness of the pulp rendering them coarse when compared with the roseberry or scarlet. For preserves they are well adapted, on account of the quality just mentioned, and also of their flavour.

American Cranberry.

American Cranberry.—As a new and recent addition to our hardy cultivated fruits, the American Cranberry (Vaccinium macrocarpon) deserves particular notice. It is distinguished by the smoothness of the stems, and the largeness of its fruit. It grows freely, and produces its fruit readily, in any damp situation, though not absolutely marshy; but wherever there is a pond, it may be cultivated with the greatest success. The margin of the pond, or a part of it, if large, is to be prepared, by driving in stakes a short way within the water line; boards are so placed against these, as to prevent the soil of the cranberry-bed from falling into the water. Small stones, such as are raked from the garden borders, are laid in the bottom; and over these, peat or bog earth, mixed with sand, to the extent of about three or four inches above, and half a foot below, the usual surface of the water. If the plants be placed at six feet asunder in this prepared border, they will cover the whole superficies of it in the course of two seasons, by means of their long runners, which take root at different points. Particular attention should be paid to this circumstance, that there are two varieties of the American cranberry, one very productive of fruit, the other not so; of course, the former is to be greatly preferred. From a small space, a large quantity of cranberries may be gathered: if the bed be thirty or forty feet in length, by five or six in breadth, a quantity will be procured sufficient for the supply of a family throughout the year. The cranberries are easily preserved in bottles, till wanted for use in tarts or otherwise.

Tender exotic Fruits.

Tender Exotic Fruits.—Notice may here be taken of one or two tender exotic fruits, which have of late years been cultivated in our hot-houses.

Granadilla.

The Granadilla Vine (Passiflora quadrangularis) is, in some places in England, particularly at Harewood House, treated as a fruit bearing plant. The fruit, called Granadilla in the West Indies, is of a greenish-yellow colour, the size of a goose-egg, sweet, and of a very pleasant flavour. The temperature of the warmest hot-house is necessary for its production. The plant is pruned much in the manner of the grape-vine. The only peculiar part of the culture seems to consist in annually cutting-in the roots to within six inches of the stem, and giving at the same time a supply of fresh rich loam. (*Lond. Hort. Trans.* Vol. IV. Part I.) It is proper likewise to assist the fecundation of the germen, by drawing a camel's-hair pencil over the anthers, and applying it to the style.

Purple-fruited Passion Flower.

The Purple-fruited Passion-flower (Passiflora edulis) is now to be found in many stoves around London, treated as a fruit-bearing plant. The produce, which is ready about November and December, is abundant, and beautiful to the eye; but we cannot help thinking, that the very large space occupied by the plant might be better employed. The finest specimens of this fruit scarcely surpass in quality the common red magnum plum, to which they bear some resemblance.

Lo-quat.

The Lo-quat (Mespilus Japonica) has for a number of years been cultivated as a fruit-bearing tree in the hot-houses at the seat of Lord Bagot in Staffordshire. The mode of culture adopted by his Lordship is described in the third volume of the *London Horticultural Transactions.* The plants, which are kept in large pots, and are six or seven feet high, are set out of doors from the middle of July till the middle of October, thus imitating the winter of their native climate. They are then removed into the warmest situation in the stove. They flower in December, and ripen their fruit about March. The fruit is much esteemed in the East Indies; but a gentleman who had eaten it in Ceylon, gave the preference to that produced in our hot-houses. The cultivation of the lo-quat is extending, the plant already existing in many collections where it has never been treated as a fruit-bearing tree.

The Orangery.

Orange Trees.

It may be doubted if more attention be now paid to the orangery than in former times. Perhaps the number of large orange trees in the country has rather declined. Still, however, their culture has in some places been improved, and kinds are now cultivated with success which were formerly little known. The Citron and the Lemon are more hardy than the Orange; and the former is, therefore, preferred for training on trellises, or for covering the back wall of a hot-house. Mr Benham at Islesworth near London, and Mr Henderson at Woodhall near Glasgow, are, we believe, among the most successful cultivators of the orange tribe, in this country. The *Malta orange,* or Sweet Philippine orange, has lately been introduced. It

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is distinguished by its round shape and reddish-yellow rind, but more especially by the crimson colour of its juice. The fruit is small, at least in our orangeries. The *Shaddock* often attains with us a large size, the fruit weighing from 4 lb. to 8 lb. or upwards; but it is fit only for making preserves.

By grafting, on small stocks, with cions on which the fruit or flowers are already formed, dwarfish fruit-bearing trees are produced, very ornamental in the green-house. For this operation, the *Mandarin orange* is well adapted, the young fruit being more firmly fixed than that of most others. It is necessary, however, to have the air for some time excluded from the grafted plants, by means of large bell-glasses; and success is promoted, by placing the plants for a few days in a slight hot-bed.

FLOWER GARDEN AND SHRUBBERY.

Under this head, the improvements may be considered as consisting chiefly in the introduction of various ornamental shrubs and flowers, formerly unknown to our pleasure-grounds and parterres. All that here seems necessary, therefore, is to mention the most important of these, and to take notice of any peculiarities in their culture.

New Roses.

The first place is perhaps due to several new species of Rose from China, which have of late years added wonderfully to the beauty and richness of our flower gardens. 1. The *Blush China-Rose* (Rosa Indica) is so hardy, that it often unfolds its elegant pale red flowers early in the spring, notwithstanding the ungenial weather which we generally experience at that season of the year, and it continues displaying a succession of flowers till November. It is almost without scent; but the flowers are very showy and produced in great profusion. There is a sweet-scented variety, which is of dwarfish stature and not so hardy. When this is placed in a conservatory, it proves highly grateful by its odour, as well as ornamental by its delicate colour: it should, however, be observed, that there are two sorts of this; one having a much richer perfume than the other. 2. The *Crimson China-Rose* (R. semperflorens) is an elegant spreading shrub. It requires a sheltered situation, and in general succeeds best when trained on the outside of a green-house or hot-house wall. Some varieties with semi-double flowers are extremely beautiful, and worthy of a place in the conservatory. 3. The *Macartney Rose* (R. bracteata), although neither so hardy nor so beautiful as the preceding, tends also to decorate the exterior of our hot-houses with its milk-white flowers, during the greater part of the summer. 4. The *Bramble-flowered Rose* (R. multiflora) requires to be trained against a wall with a southern aspect: here, however, it often proves very ornamental, the flowers coming forth in large clusters. 5. *Lady Banks's Rose* (R. Banksiæ) is remarkable for the elegance of its foliage; and it is hardy, growing pretty freely in our open borders, and producing its blossoms readily.

White Moss Rose.

A *white* variety of the Moss Rose has of late attracted much notice, on account of its rarity and uncommon appearance. It does not appear to be very permanent, but rather apt to return to the usual hue.

The *Ayrshire Rose* (R. capreolata of Don) has likewise excited a good deal of attention. It grows with great rapidity, and has been found very useful for covering any offensive wall, paling, or roof. There are two kinds; the one most commonly sold in the public nurseries is merely Rosa arvensis, a native of this country: the other is more nearly allied to R. sempervirens, a native of the south of Europe; from which, however, it differs considerably in habit; in particular, the Ayrshire rose is more hardy, and grows more freely, and during winter it does not retain its leaves nearly so much as the sempervirens.

Many varieties of the *Scots Rose* (R. spinosissima) have been raised; some double, others semi-double, but variously coloured in the petals. These, it may be remarked, naturally flower early in the summer; and it seems reasonable, therefore, to regard them as well adapted for forcing in the spring.

Japan Shrubs.

Some very ornamental Japan shrubs are particularly deserving of notice. 1. The *Corchorus Japonicus* (or Kerrea Japonica), trained against a north or east wall, retains its leaves through the winter, and early in the spring produces its rich yellow blossoms in profusion. 2. The *Japan Apple* (Pyrus Japonica), trained on the outside of a green-house or hot-house, displays at the same early season its beautiful red blossoms. A white-flowered variety has likewise been introduced, and forms a good contrast with the other. In favourable situations the fruit often attains a considerable size during summer; but the shrub is of importance only in the way of ornament. 3. The *Gold Plant of Japan* (Aucuba Japonica) highly adorns the shrubbery, especially during winter, by its brilliant leaves, blotched with gold yellow. In sheltered situations it sustains our ordinary winters without injury.

Siberian Lilac.

A variety of the lilac-tree, apparently a hybridous production between the common and the Persian, is now cultivated, under the name of *Siberian Lilac*. It forms a pretty shrub, the size of the leaf being intermediate between that of the two old species. It seems to be the *Varin* of the French.

Yellow Currant.

Ribes aureum, or the Yellow-flowered Currant, makes a fine appearance when covered with its blossoms in May. It requires a sheltered place, or to be trained to a wall.

Irish Ivy.

Ireland has, within these few years, produced three very ornamental varieties, all of them evergreens. 1. The most important is a broad-leaved ivy, usually distinguished by the name of *Irish Ivy*. For all the purposes for which ivy is desirable in a garden, this kind is preferable. It not only grows more freely, but its leaves are four times larger than in the common ivy, and of a brighter green. For decorating or disguising the back of a wall, it is well calculated, on account of the beauty of the leaves; for covering a rock or an aged tree in the pleasure grounds, it is equally adapted. 2. The next is a kind of Yew-tree, first observed at Florence Court, in the county of Fermanagh, remarkable for its upright growth, and commonly

distinguished by the name of *Irish Yew*. It forms a very fine object in the shrubbery, its dark foliage contrasting with the light hue of the cypress or the Swedish juniper. It is so different in aspect from the common yew, that some regard it as a distinct species. 3. The *Irish Furze* is a very recent production, and it is likewise remarkable for its upright growth. For small cross hedges, or *brise-vents*, in flower-borders, it is very desirable, being at the same time curious and ornamental, and completely answering the purpose. It is propagated by cuttings, but these do not strike very readily.

For the many fine flowering shrubs which require a bog soil, compartments are now prepared with great care, generally in a low situation, or by the side of a rivulet or pond. Surface peat-earth, having a considerable portion of fine sand intermixed with it, forms the most desirable soil. From the circumstance of several of the most showy plants (particularly the whole genus Kalmia, with different species of Azalea and Andromeda, and one fine Rhododendrum, R. maximum), being natives of America, these compartments are generally called the *American grounds*. The list of plants adapted to those grounds has been considerably increased. Rhododendrum Catawbiense, Caucasicum, and Dauricum, may be particularly specified, with Andromeda pulverulenta and cassinefolia; and some new varieties of Azalea nudiflora and viscosa.

The *Tree-peony* or *Moutan*, if planted in a sheltered situation in the garden, and protected by a temporary cover during winter, forms a most beautiful ornament when in flower in the beginning of summer.—This may be considered as a connecting link, leading from the notice of shrubs to herbaceous plants. But here brevity must be studied; and only a few of the most ornamental can be named.

The different species and varieties of herbaceous Peony may first be noticed, these having, of late, been much in vogue, and getting in many places a separate border of the flower-garden allotted to them. The following are at present cultivated: P. corallina; paradoxa fimbriata, or double-fringed; peregrina compacta, or byzantina; albiflora, in three subvarieties, with single flowers, with double flowers, and double sweet-scented (the latter one of the finest); daurica; tenuifolia, anomala, or genuine laciniata; albiflora Tatarica, or Sibirica; officinalis with double red flowers (one of the oldest inhabitants of our gardens); the same with double flesh-coloured flowers, and a still paler variety approaching to white.

The cultivation of *Dahlias* has become fashionable, and they must not, therefore, be omitted.—There are two species, D. superflua and D. frustranea. Of the former there are purple, scarlet, and rose-coloured varieties; of the latter, saffron-coloured and white. Occasionally most of these are procured with double or semi-double flowers, and these are most highly prized by florists. The roots, which are tuberous like those of the common peony, are taken up in autumn, and kept in a dry place, beyond the reach of frost, till the time of planting in the spring. Burying them among sand is unnecessary, and often proves hurtful. In April the more choice kinds should be planted in pots, so as to have their growth forwarded in a frame or green-house. In June they may be planted out: a rich border is not desirable for them; on the contrary, the flowers come more brilliant in a poor soil. If the plants show a great disposition to be luxuriant, the flowering is impaired: this disposition may be somewhat checked, by pinching off some of the secondary branches while young and tender. After the flower-bud has appeared little water should be given to the plants, even though the weather should prove dry.

The Cardinal flower (Lobelia cardinalis) was long admired; but it is surpassed by two species lately introduced, *Lobelia fulgens* and *L. splendens*. These are fortunately more hardy, or at least more easily kept than the former. In mild winters they stand perfectly well in the open borders; but the stools should be separated in the spring, the young slips forming much finer plants. It may be proper, however, to preserve two or three well-established plants of each kind in pots in the green-house during winter, and to divide the sets in spring at the time of planting out. A compartment in the flower-garden filled with these, makes a most brilliant appearance in the months of August and September. If it is wished to see them in full luxuriance and splendour, more care is requisite. The offsets should be potted in October, and kept in a frame or cool green-house till the spring, when they should be repotted and subjected to increased temperature. During their growth they should be kept very moist, perhaps even with a pan of water under the pot. Treated in this way, they become as strong and tall as plants of the Pyramidal Bell-flower (Campanula pyramidalis); and as they produce their flowers at the same period, the blue and crimson form a fine contrast.

The *Tiger-spotted Lily* of China (Lilium tigrinum) is a valuable acquisition, being quite hardy, and, when planted in a considerable clump, becoming extremely ornamental. It succeeds well in soil prepared with a portion of bog-earth, somewhat in the manner of the American ground. The bulbs may be left in the ground without risk of injury, unless the situation be very damp. They multiply rapidly at the root, however, by means of offsets; and the roots must, therefore, be occasionally parted. The plant is also readily propagated by means of the small bulbs produced in the axillæ of the leaves.

The *Mexican Tiger-flower* (Tigridia pavonia) succeeds pretty well in the front of a hot-house, and for several weeks expands daily some of its most gorgeous, but transitory flowers. The roots require to be lifted at the approach of winter, and to be kept carefully from the access of frost.

Great attention has, for some years past, been paid to the important subject of rendering the plants of warmer countries sufficiently hardy to enable them to sustain our variable climate. The most effectual way is to endeavour to bring such plants to ripen their seeds in the open air in this country with as little assistance from glass as possible; and then to sow these seeds, from which a somewhat more hardy progeny may be looked for. By continuing this mode for several successive generations, the plant may (according to the theory of Sir Joseph Banks,

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when treating of the Canada rice) be completely naturalized.

Green-house and Conservatory.

The additions to the ornamental inhabitants of the green-house or the conservatory have, of late years, been very great. We can only notice a few of them, and these very generally.

CapeHeaths.

The *Heaths* of the Cape of Good Hope have proved so numerous, and, at the same time, so beautiful, that, in many places, a separate green-house has been established for them, under the name of the Heathery. About 240 species are now cultivated; and they are highly worthy of the care and expence bestowed on them, some species or other being in flower in almost every month of the year, and several of them being fragrant. Most of them have been figured by Mr Andrews, in a splendid work, entitled, *Engravings of Heaths, with Botanical Descriptions.* All the ericæ grow best in a mixture of bog-earth and sand. They require as much free air during winter as can be given to them, without absolutely subjecting them to frost. They are generally propagated by cuttings, as many species do not produce their seeds in this country; and he is accounted an expert propagator, who succeeds readily in striking cuttings of Erica ardens, taxifolia, Massoni, retorta, articularis, and elegans.

Geranium.

The number of showy *Geraniums* has greatly increased; the raising of seedling varieties having for some years been a favourite occupation of florists. Some of the finest are varieties of Pelargonium inquinans, with flowers of an intensely crimson colour, and with semi-double flowers; others with large blossoms, finely marked on a light ground, have sprung from P. cucullatum.

Tree Mignonette.

A simple but desirable addition to the ornament of the green-house or the lobby must not be passed over. A variety of *Mignonette* has been introduced, which, when kept in pots, remains in flower, and, what is more important, in full fragrance, throughout the winter. By training, it is made to assume somewhat of a shrubby appearance, and is called Tree Mignonette. It seems to be a variety very distinct from the common kind; the leaves are much smaller, and the flowers are produced in greater abundance.

The Dry Stove has received rich accessions to its treasures, in numerous new species of Stapelia and Mesembryanthemum.

Acacias.

The Conservatory is now filled with the curious and beautiful Acacias of New Holland. These are not less remarkable for their singular foliage (which is generally upright, and acts equally on light in every direction, or, in other words, the leaves have no upper and under surface), than for the profusion in which they display their rich yellow flowers in the spring season.

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Camellias.

The Japan Rose (Camellia Japonica) must not be forgotten; for some most beautiful varieties, forming the pride of the conservatory, have appeared within the last few years; particularly the waratah or anemone-flowered, both with double red flowers and with double white flowers, the latter often called the Pompone camellia.

Hydrangea.

The Hydrangea hortensis succeeds in the open border in good seasons; but it is always much injured during winter. If room can be spared in the conservatory, it makes a much finer appearance there; and, according to Mr Hedges (*Lond. Hort. Trans.* Vol. III.), by planting it in pure yellow loam, the flowers may be procured of the beautiful blue colour sometimes observed in this species,—an experiment, however, which does not always succeed.

Aquatics.

Tender *aquatics,* of the genera Nymphæa, Nuphar, Menyanthes, and Nelumbium, are now cultivated with great success in frames resembling those used for the raising of melons. The plants are placed in cisterns, made of wood and lined with lead, about four feet in length, and two feet and a half in breadth; and these cisterns are plunged in tanners' bark or stable dung. In this way the plants flower much more freely and beautifully than when kept in lofty hot-houses heated by flues.

From the details which have been given, it pretty clearly appears, that great advances are making in the knowledge and practice of an improved horticulture. For this fortunate state of matters, we are in no small degree indebted to the two patriotic associations, the *Horticultural Society of London* and the *Horticultural Society of Edinburgh,* already mentioned. Both consist of several hundred members, all of them amateurs of gardening. Among them, horticultural knowledge must rapidly increase, and a beneficial feeling of friendly emulation cannot fail to be excited. Both societies distribute honorary rewards for excellence in any of the productions of the garden, or for the encouragement of well-contrived experiments. Both publish *Transactions,* which have been repeatedly quoted in the preceding pages; thus affording equally to the scientific cultivator and to the practical gardener a convenient medium for communicating to the public notices of useful improvements. The London Society has already given to the world three volumes in quarto, embracing many important subjects, some of them illustrated by engravings in the first style of excellence. The Scottish Society has published two volumes in octavo, likewise meritorious as to matter, but with slender pretensions to ornament or illustration. (G.G.G.)

ADDENDUM

TO

VOLUME FOURTH.*

EQUATIONS.

1. In all the applications of Algebra, it is not the magnitudes concerned that we immediately consider, but merely their proportions. In every class of quantities of the same kind, one being adopted as the unit of comparison, all the rest are referred to this standard, and are represented by the proportions they bear to it. The letters of the alphabet, or other symbols used in Algebra, are not, therefore, properly speaking, the representatives of magnitudes; they denote ratios, or abstract numbers, viewed, as in the fifth book of Euclid, in the most general manner, and independently of any particular system of arithmetic or numeration.

The ancient Geometry follows a different procedure. In that science the attention is in every case confined to the magnitudes under actual consideration. A general property of triangles is established, by showing, that it is true of any particular triangle that comes under the proposed hypothesis. The geometer contemplates particular instances, presenting, for the most part, relations not very complex, and easily kept in view. On this account he carries on his investigations with the greatest clearness, and is in no danger of falling into contradiction or paradox. But his science is little susceptible of general methods. If any process within the compass of the ancient geometry be entitled to that appellation, it is what is called the method of exhaustion. Every geometer perceives that all the demonstrations under this head have the closest analogy. Yet, after a hundred applications, it is still necessary, in any new case, to pursue the reasoning through all its details, without deriving assistance from any general conclusion previously obtained.

Algebra possesses a great advantage over geometry in generalizing its processes. Problems relating to magnitudes of the most different kinds, nevertheless, lead to similar expressions in numbers. Questions in geometry, in mechanics, or concerning mercantile business, are made to depend on the same rules for their solution. It may be said that algebra and the modern analysis accomplish, for all the mathematical sciences, the project, entertained by some ingenious men, of an universal and philosophical language, which, being founded on an exact scrutiny into the nature of things, and on what they possess in common, might greatly facilitate the acquisition and the extension of our knowledge.

The spirit of generalization peculiar to algebra is no where more conspicuous than in the doctrine of equations. Every determinate problem that can occupy the attention of the mathematician, is ultimately reduced to the finding of such numbers as are necessary to determine the unknown quantity or quantities, by means of the equations that subsist between those numbers, and others which are given in the question. A wide field of mathematical investigation is thus brought under a limited number of algebraic expressions.

In treating of equations it will not be necessary to begin with laying down a formal definition. We confine ourselves, in this article, to the consideration of such equations as contain only one unknown quantity. We further suppose, that the elementary operations preparatory to solution are already performed; so that the unknown quantity is clear of radical signs, and is no where found in the denominator of a fraction: likewise that all the separate terms are

Equations.

* See the word Equations, p. 175 of this Volume.

Equations.

brought to one side of the sign of equality, and arranged in such a manner, that the first term, which must always be positive and have unit for its index, contains the highest power of the unknown quantity or x; the second term contains the next highest power, and so on, the term which does not contain x being placed last. This arrangement must always be understood when any term is distinguished by the order it stands in; but it will sometimes be convenient to write the terms in an inverted order, arranging them according to the indices of the unknown quantity.

Equations are divided into different classes or orders, according to the highest power of the unknown quantity found in their terms.

An equation of the first degree, or a simple equation, is one which contains x only, without any of its powers, as $x-A=o$.

A quadratic equation, or one of the second degree, contains the square of x, as $x^2-A=o$, or $x^2-Ax+B=o$.

A cubic equation, or one of the third degree, contains the cube, or third power of x, as $x^3-A=o$, or $x^3-Ax^2+Bx-C=o$.

A biquadratic equation, or one of the fourth degree, contains the fourth power, or biquadrate, of x, as $x^4-A=o$, or, $x^4-Ax^3+Bx^2-Cx+D=o$.

And, in general, an equation of the n^{th} degree contains the n^{th} power of x, and the powers inferior to the n^{th}, such as

$$x^n-Ax^{n-1}+Bx^{n-2}\ldots\ldots\ldots-Mx+N=o.$$

A root of an equation is a value of the unknown number x. Thus, if a represent a number, and if its powers, a, a^2, a^3, &c. when they are substituted in the equation for x, x^2, x^3, &c. produce an equality between the positive and negative terms, then a is a root of the equation, and it is a positive root; but if, for x, x^2, x^3, &c., we must substitute $-a$, a^2, $-a^3$, &c., which are the powers of $-a$, in order to obtain the like equality, then a is a negative root of the equation.

What we have here called roots are more generally named *real roots*, to distinguish them from those expressions to which the appellation of *imaginary or impossible roots* has been given. As it will conduce to perspicuity, we shall always use the word root in the sense here defined, unless when imaginary or impossible roots are expressly mentioned.

From the definitions laid down, it follows that the negative roots of the equation,

$$o=N+Mx+Lx^2+Kx^3+\text{ \&c.}$$

are the same with the positive roots of the equation,

$$o=N-Mx+Lx^2-Kx^3+\text{ \&c.}$$

in which the signs only of all the terms containing the odd powers of x are changed. For the same result is obtained, whether we make x equal to $-a$ in the first equation, or to $+a$ in the second.

2. A great advantage has resulted from the practice introduced by Harriot, of writing all the terms of an equation on one side of the sign of equality. The polynomes formed by all the terms thus brought together are rational and integral functions of the unknown quantity; and the question is, to find in what circumstances such expressions are equal to zero. The most likely way of succeeding in this research, is to resolve the functions into their most simple component factors. Harriot supposed that every rational function can be produced by the continued multiplication of binomial factors; and, in this, he has been followed by succeeding algebraists. The modern theory of equations is entirely founded on this supposition, which, although it has not been demonstrated, has yet, in some measure, been verified in the progress of the science, and by the admission of those artificial expressions called imaginary or impossible quantities. But there is a distinction between the real and impossible binomial factors of a rational polynome. For the first are expressions complete and significant by themselves, without reference to other quantities; whereas one impossible factor necessarily supposes the existence of another, the two related expressions being such, that their multiplication produces one real factor of the second degree. Thus, every pair of impossible factors is equivalent to a real quadratic factor; and, by an unavoidable consequence of the forced supposition made by Harriot, the attention of algebraists has been drawn to the two impossible expressions, instead of being directed to the real one which they compose. In order to place the doctrine of equations and the theory of impossible roots on a solid foundation, it appears necessary to attempt the resolution of rational functions into their component factors by a rigorous analysis, free from arbitrary suppositions.

To resolve the rational function $f(x)$ into its component factors, we must begin with inquiring, whether it can be divided without a remainder, by a division such as $x-a$, or $x+a$? If it can, the proposed function will be equal to $(x\mp a)\times f'(x)$, where $f'(x)$, the quotient of the division, is a function similar to $f(x)$, but of an order one degree lower. In like manner, it may be possible to reduce $f'(x)$ to a degree still lower, by means of one or more divisors of the same form; and, in certain cases, the first function may be entirely exhausted by successive binomial divisors. When this happens, the divisors $x-a$, $x-b$, $x-c$, &c. will be equal in number to the exponent of the highest power of x, and their continued product will be equal to $f(x)$. It is evident, that by multiplying together a proper number of such factors, an algebraic expression may be formed similar to any rational and integral function, and the coefficients of this product will likewise contain as many quantites to be determined at pleasure as there are coefficients in the given function. But we should reason badly if, from this process of composition, we should infer that a product arising from the multiplication of a certain number of simple factors may have any given coefficients, or will coincide with any proposed polynome of the same degree. This is a point that can be ascertained only by a process of analysis or resolution, and by seeking all the binomial divisors any given function admits of. In fact, the cases are extremely rare in which an algebraic function can be completely exhausted by real binomial divisors. There are many polynomes which

have not a single divisor of this kind; and, in the progress of resolution, we generally arrive at a function which cannot be further divided. When this is the case, it must be tried whether a quadratic divisor, as x^2+mx+n, will not be successful in lowering the function. But here it must be observed, that such divisors are of two kinds; one, as $(x-\varrho)^2-r^2$, which can be resolved into two binomial factors; and one as $(x-\varrho)^2+r^2$, which cannot be so resolved without introducing imaginary or impossible expressions. Now, to divide by a divisor of the first kind is the same thing as to divide by the two binomial factors of which it is composed; and, therefore, it is the second kind of quadratic factors only that need be tried, or that can succeed, in lowering a function already deprived of all its simple divisors. After quadratic divisors those of the third degree would naturally come to be considered; but this is unnecessary, because algebraists have found that every rational function may be completely exhausted by simple and quadratic factors.

What has now been said naturally distributes the subject under two heads; one treating of the simple or binomial factors, and the other of the quadratic or trinomial factors, of algebraic equations.

Binomial Factors.

3. The first object of inquiry must be to find the conditions necessary, in order that a binomial quantity, as $x-a$, or $x+a$, shall divide a rational polynome without a remainder. Suppose that $x-a$ is a divisor of the polynome,

$$x^n+Ax^{n-1}+Bx^{n-2}\ldots\ldots+Mx+N,$$

which we shall denote by $f(x)$: then we shall have

$$f(x)=N+Mx+Lx^2+Kx^3+\&c.$$
$$f(a)=N+Ma+La^2+Ka^3+\&c.$$

wherefore, by subtracting and dividing by $x-a$, we get

$$\frac{f(x)}{x-a}-\frac{f(a)}{x-a}=M\frac{x-a}{x-a}+L\frac{x^2-a^2}{x-a}+K\frac{x^3-a^3}{x-a}+\&c.$$

Now, it is known, that the difference between any like powers of two numbers is exactly divisible by the difference of those numbers: hence all the quantities on the right-hand side of the sign of equality form an integral expression. But as $f(a)$ does not contain x, it cannot be divisible by $x-a$; it follows, therefore, that $f(x)$ cannot be divisible by $x-a$, unless $f(a)=o$; and it is obvious, that this condition is the only one necessary. Thus, the polynome $f(x)$ will be divisible by $x-a$, when a is a positive root of the equation $f(x)=o$; otherwise not.

Again, let the divisor be $x+a$: then,

$$f(x)=N+Mx+Lx^2+Kx^3+\&c.$$
$$f(-a)=N-Ma+La^2-Ka^3+\&c.$$

and, by proceeding as before,

$$\frac{f(x)}{x+a}-\frac{f(-a)}{x+a}=M.\frac{x+a}{x+a}+L\frac{x^2-a^2}{x+a}+K.\frac{x^3+a^3}{x+a}+\&c.;$$

here again all the divisions on the right-hand side of the sign of equality can be exactly performed: and we must, therefore, conclude that $f(x)$ will be divisible by $x+a$ only when $f(-a)=o$, that is, when a is a negative root of the equation $f(x)=o$.

Now $x\mp a$ being a divisor of $f(x)$, the quotient, which we may denote by $f'(x)$, will be a polynome of $(n-1)$ dimensions, or one degree lower than $f(x)$: and we shall have

$$f(x)=(x\mp a)\times f'(x).$$

From this equation, it appears that every value of x that makes $f'(x)$ equal to zero, will likewise make $f(x)$ equal to zero: consequently, every binomial divisor of the first function will likewise be a divisor of the second. And, if $f'(x)$ has no roots, and no binomial divisors, neither will $f(x)$ have any roots except $\pm a$, nor any binomial divisors except $x\mp a$. Suppose that the polynomes $f(x)$ and $f'(x)$ have the common root $\pm b$; they will likewise have the common divisor $x\mp b$; and if we put $f''(x)$ for the quotient arising from the division of $f'(x)$ by $x\mp b$, so that $f'(x)=(x\mp b)\,.f''(x)$; we shall have

$$f(x)=(x\mp a)\,.\,(x\mp b)\,.f''(x),$$

in which equation $f''(x)$ is a polynome of $n-2$ dimensions, or two degrees lower than $f(x)$.

It is evident, we may continue to reason in the same manner, either till, after successive divisions, we come at last to a binomial quotient, in which case the original polynome $f(x)$ will be completely resolved into binomial factors; or till we come to a quotient that has no roots, in which case $f(x)$ will have no binomial factors except those previously found. We may, therefore, conclude that "a rational polynome has as many binomial factors as it has roots, and no more; every positive root producing a factor of the form $x-a$, and every negative root one of the form $x+a$: and since the number of binomial factors can never be greater than the dimensions of the polynome, its roots cannot exceed the same number."

4. There are very few cases in which it can be known immediately and by inspection, that an equation has one or more roots. These cases depend upon the following proposition, viz. "If $\varphi(x)$ denote a rational polynome having x, or some integral power of x, in every one of its terms, and likewise having the term that contains the greatest power of x positive, a value of x may be found that will make $\varphi(x)$ equal to any positive quantity, as s."

Suppose, first, that all the terms of $\varphi(x)$ are positive; then, x^n being the first term, or that in which x rises to the highest power, if $s=t^n$, and $\lambda>t$, it is manifest, that

$$\varphi(\lambda)>t^n>s.$$

Therefore, while x increases from o to be equal to λ, the function $\varphi(x)$ increases from o to be greater than s; and as the variations of $\varphi(x)$, however irregular

they may be, are connected by the law of continuity, the function will pass through every gradation of magnitude between o and the greatest limit $\varphi(\lambda)$. Consequently, there is a value of x between o and λ, that will make $\varphi(x)$ equal to s.

When the terms of $\varphi(x)$ are not all positive, let all the positive terms except x^n be rejected, and all the negative terms be retained, and we shall have φx equal to, or greater than,

$$x^n - Fx^{n-i-1} - Hx^{n-i'-1} - \&c.$$

But, s being equal to t^n, we have

$$t^n = x^n - (x-t) \cdot \left\{ x^{n-1} + tx^{n-2} + t^2x^{n-3} \ldots + t^{n-1} \right\}$$

Now, by equating the negative terms of the first expression to the terms containing the like powers of x in the value of t^n, we shall get

$$(x-t) \cdot t^i = F$$

$$(x-t) \cdot t^{i'} = H$$

&c.

And hence,

$$x = t + \frac{F}{t^i}$$

$$x = t + \frac{H}{t^{i'}}$$

&c.

Let λ be either equal to, or exceed the greatest of these values of x; then we shall have

$$\varphi(\lambda) > t^n > \varsigma.$$

Wherefore, as before, there is a value of x between o and λ, that will make $\varphi(x)$ equal to ς.

From what has now been proved, we derive the following properties of equations.

1. "Every equation of odd dimensions has at least one positive root when the last term is negative, and one negative root when the last term is positive."

If the last term be negative, as in this instance,

$$x^{2n+1} + Ax^{2n} + Bx^{2n-1} \ldots + Mx - N = o;$$

according to what has been proved, a value of x, viz. a, may be found that will satisfy the condition,

$$a^{2n+1} + Aa^{2n} + Ba^{2n-1} \ldots + Ma = N;$$

then a is a positive root of the equation.

When the last term is positive, as in this equation,

$$x^{2n+1} + Ax^{2n} + Bx^{2n-1} \ldots + Mx + N = o;$$

change the sign of the last term, and the signs of all the terms that contain the even powers of x, then the polynome will become

$$x^{2n+1} - Ax^{2n} + Bx^{2n-1} \ldots + Mx - N:$$

and a value of x, viz. a, may be found such that

$$x^{2n+1} - Aa^{2n} + Ba^{2n-1} \ldots + Ma = N:$$

now transpose N, and then change the signs of all the terms, and we shall get

$$-a^{2n+1} + Aa^{2n} - Ba^{2n-1} \ldots - Ma + N = o,$$

which shows that a is a negative root of the equation.

2. "Every equation of even dimensions having its last term negative, has two roots, one positive and one negative."

Let the equation be

$$x^{2n} + Ax^{2n-1} + Bx^{2n-2} \ldots + Mx - N = o;$$

and consider the polynomes,

$$x^{2n} + Ax^{2n-1} + Bx^{2n-2} \ldots + Mx - N,$$

$$x^{2n} - Ax^{2n-1} + Bx^{2n-2} \ldots - Mx - N,$$

in the latter of which the signs of all the terms containing the odd powers of x are changed; then there are two values of x, viz. a and b, such as to answer the conditions,

$$a^{2n} + Aa^{2n-1} \ldots + Ma = N$$

$$b^{2n} - Ab^{2n-1} \ldots - Mb = N:$$

consequently a is a positive, and b a negative root of the equation.

3. "A polynome of even dimensions, which has no binomial factors, is always positive, whatever value be substituted for the unknown quantity."

Let the polynome be $f(x)$, or

$$x^{2n} + Ax^{2n-1} \ldots Mx + N:$$

then the last term, or that term which does not contain x, must be positive; for, otherwise, the polynome would have two roots, and two binomial factors, contrary to the hypothesis. Now, if it be possible, let the polynome have a negative value when λ is substituted for x, so that $f(\lambda) = -P$; therefore, when $x = o$, $f(x)$ is equal to the positive quantity N; and, when $x = \lambda$, the same function is equal to $-P$; but since $f(x)$ passes through all degrees of magnitude between N and $-P$, while x varies from o to λ, it will become equal to zero when x has some intermediate value; therefore the polynome has one root between o and λ, and one binomial divisor corresponding to that root contrary to the hypothesis.

It may be observed, that the converse of this proposition is not true; for a polynome of even dimensions, that has such factors as $(x-a)^2$, $(x-a)^4$, $(x-a)^{2m}$, may never become negative, although it is capable of being equal to zero.

5. The properties demonstrated in the last section lead to this general proposition relating to the number of roots in any equation, viz. "In any equation, the number of all the roots is even when the dimensions are even, and odd when the dimensions are odd."

For every equation has as many binomial divisors as it has roots; and if we suppose an odd number of roots in an equation of even dimensions, or an even number in one of odd dimensions, the last quotient, after dividing successively by all the divisors, would be a polynome of odd dimensions, having at least one root, which would likewise be a root of the proposed equation. Therefore the number of all the roots of an equation cannot be even when the dimensions are odd, nor odd when the dimensions are even.

Equations.

And again, since every polynome is equal to the continued product of all its binomial divisors, and the quotient last found, after dividing by them all successively, we obtain the following proposition, viz.: "Every rational polynome is equal either to the continued product of as many binomial factors as it has dimensions; or to the continued product of an even or odd number of such factors, according as the dimensions of the polynome are even or odd, and a polynome of even dimensions, which, having no binomial factors, is always positive, whatever value be substituted for the unknown quantity."

Equal roots.

6. When several of the binomial factors of an equation are equal to one another, it is said to have so many equal roots. In this case, the equation can be divided a number of times successively by the same binomial divisor. Thus, an equation which is twice divisible by $x-a$, or, which is the same thing, once by $(x-a)^2$, has two roots equal to a; and, if it can be divided by $(x-a)^m$, it has m roots equal to a.

The most obvious way of finding the conditions on which the equality of the roots depend would, therefore, be to expand the divisor $(x-a)^m$ by the binomial theorem, and then divide the equation by it: for, after the integral quotient is obtained, the required conditions will be found by making the several parts of the remainder separately equal to zero. The number of the conditions found in this manner is equal to the exponent of the divisor; for of so many parts will the remainder of the division consist. But, in a complex operation, it is difficult to ascertain the remainder; and besides, it is not necessary to consider all the equations obtained by this process, because both the number and the value of the equal roots can be found by means of two of them only.

The inconveniences, just mentioned will be avoided by proceeding in the following manner: Let the equation be

$$x^n+Ax^{n-1}+Bx^{n-2}\ldots+Mx+N=o:$$

then, if it be divisible by $(x-a)^m$, the quotient will be a polynome of $n-m$ dimensions; and we may, therefore, suppose that the expression

$$x^n+Ax^{n-1}+Bx^{n-2}\ldots+Mx+N,$$

is equal to the product,

$$(x-a)^m\times\left\{x^{n-m}+A'x^{n-m-1}+B'x^{n-m-2}+\&c.\right\}.$$

In these expressions, x may have any value whatever; and, therefore, the equality between them will still subsist if we substitute $x+i$ for x, i being any arbitrary number; therefore the expression

$$(x+i)^n+A(x+i)^{n-1}+B(x+i)^{n-2}\ldots+M(x+i)+N,$$

will be equal to the product,

$$(x-a+i)^m\times\left\{(x+i)^{n-m}+A'(x+i)^{n-m-1}+\&c.\right\}.$$

Now, let the several powers of $(x+i)$ be expanded by the binomial theorem, and put

$$X=x^n+Ax^{n-1}+Bx^{n-2}\ldots+Mx+N,$$

$$Y=nx^{n-1}+(n-1)Ax^{n-2}+(n-2)Bx^{n-3}\ldots+M,$$

$$Z=n.\frac{n-1}{2}.x^{n-2}+(n-1).\frac{n-2}{2}Ax^{n-3}+\&c.,$$

$$V=n.\frac{n-1}{2}.\frac{n-2}{3}x^{n-3}+(n-1).\frac{n-2}{2}.\frac{n-3}{3}Ax^{n-4}$$

$$+\&c. \quad \&c. \quad \&c.$$

then the given polynome of n dimensions will become

$$X+Y.i+Z.i^2+V.i^3+\&c. \quad (A).$$

And if the like operations are performed in the polynome of $n-m$ dimensions; and $(x-a+i)^m$ be expanded by the binomial theorem; the product of these two expressions will become

$$\left\{(x-a)^m+m.(x-a)^{m-1}.i+m.\frac{m-1}{2}.(x-a)^{m-2}.i^2\right.$$

$$\left.+\&c.\right\}\times\left\{X'+Y'.i+Z'.i^2+\&c.\right\}. \qquad (B)$$

The expression (A) being equal to the product (B), whatever i stands for, the coefficients of the like powers of i must be equal; and hence, by equating the terms in which i is wanting, and likewise the terms that contain the first power of i, we get

$$X=(x-a)^m.X'$$

$$Y=(x-a)^m.Y'+m(x-a)^{m-1}X';$$

which proves that $(x-a)^{m-1}$ is a common divisor of X and Y. If, therefore, by means of the usual process, we seek the greatest common measure of the two polynomes, X, Y, or,

$$x^n+Ax^{n-1}+Bx^{n-2}\ldots\ldots+Mx+N,$$

$$nx^{n-1}+(n-1)Ax^{n-2}+(n-2)Bx^{n-2}\ldots+M;$$

we shall obtain the factor $(x-a)^{m-1}$; and the given polynome X will be divisible by $(x-a)^m$; that is, it will contain the common factor $x-a$ once more than the polynome Y contains it.

If we proceed farther, and equate the coefficients of i^2 in the expressions (A) and (B), we shall get

$$Z=(x-a)^m.Z'+m(x-a)^{m-1}Y'+$$

$$m.\frac{m-1}{2}(x-a)^{m-2}.X';$$

which shows, that Z is divisible by $(x-a)^{m-2}$. In the same manner, it may be proved, that V is divisible by $(x-a)^{m-3}$, and so on. It appears, therefore, that the first m coefficients of the expression (A) are respectively divisible by $(x-a)^m$, $(x-a)^{m-1}$ $(x-a)^{m-2}$, &c.; and, consequently, we shall have

$$X=o,\ Y=o,\ Z=o,\ V=o,\ \&c.$$

when the common root a is substituted for x.

If the polynome X is divisible by $\left\{(x-\alpha)^2+\beta^2\right\}^n$,

Equations. it may be proved in like manner, that $\left\{(x-a)^2+\beta^2\right\}^{n-1}$ will be a common divisor of X and Y.

We may, therefore, lay down the following rule, for finding all the double, triple, &c. divisors of any given polynome X: "Find R, the greatest common measure of X and Y, and resolve it into its elementary factors; then each of these factors will be contained in X once more than in R."

Number of Positive and Negative Roots.

7. If it be required to find how many of the roots of an equation are positive, and how many are negative, we have for this purpose the rule first published in the *Geometry* of Descartes. This celebrated rule seems to have been discovered by induction; at least, its author gave no demonstration of it, and disputes arose about its true import. It was demonstrated for the first time by Du Gua, in the *Mémoires de Paris*; but many other demonstrations of it have since appeared, of which that of Segner, in the *Mémoires de Berlin* 1756, is not only the most simple, but probably the most simple that will ever be invented.

Segner deduced the rule of Descartes from the following analytical proposition, viz.

"If any rational polynome be multiplied by $x-a$, the changes from one sign to another, from $+$ to -1, and from $-$ to $+1$, will be at least one more in the product, than in the given polynome; and if it be multiplied by $x+a$, the successions of the same sign, of $+$ to $+$, and of $-$ to -1, will be at least one more."

Let the proposed polynome be

$$x^n \pm Ax^{n-1} \pm Bx^{n-1} \ldots\ldots \pm Mx \pm N;$$

then, according to the usual process, the product of the polynome by $x-a$ will be found by adding these two lines, viz.

$$\left.\begin{array}{l} x^{n+1} \pm Ax^n \pm Bx^{n-1} \ldots \pm Mx^2 \pm Nx \\ \quad -ax^n \mp Aax^{n-1} \qquad \mp Lax^2 \mp Max \mp Na \end{array}\right\}$$

the signs of the several terms remaining unchanged in the first line, and being all changed in the second line. It is evident, therefore, that the terms of the product will have the same signs with the respective terms of the proposed polynome, except when a coefficient in the second line is greater than the one above it, and likewise has a contrary sign; the sign of the last term of the product being always the same with the sign of the last term of the second line. Now, beginning on the left hand, pass over the terms of the first line, so long as they have the same signs with the terms of the product. When this ceases to be the case, the signs in the product will be the same as in the second line, and contrary to those in the first line; wherefore descend to the second line, and pass along its terms till the signs in the product are again the same as those in the first line, and then ascend to that line. Continue thus descending and ascending alternately, till all the terms in both lines are taken in. At the conclusion, it is evident, that the descendings are always one more than the ascendings, because the passing from one line to another both begins and ends with descending.

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If we descend from $\pm Ax^n$, in the first line, to $\mp Aax^{n-1}$, in the second line, it is evident, that the signs of $\pm Ax^n$ and $\pm Bx^{n-1}$, in the first line, will be the same, both being contrary to the sign of $\mp Aax^{n-1}$, in the second line. Therefore, in the given polynome, the first and second terms have the same sign. But in the product, the like terms have contrary signs; for the second term of the product has the same sign with $\pm Ax^n$ in the first line, and the third term of the product has the same sign with $\mp Aax^{n-1}$ in the second line. Thus, it appears that a variation, from one sign to another, is introduced in the product, instead of a continuation of the same sign that takes place in the given polynome; and the same thing will happen at every descending.

In ascending from the second line to the first, there may either be a continuation in the product instead of a variation in the given polynome, or the contrary: but one of these two must take place.

Now, so long as we keep on the first line, the signs in the product are the same with those of the given polynome; and, so long as we keep on the second line, the signs in the product are contrary to those in the polynome. In both cases, therefore, the variations from $+$ to -1, and from $-$ to $+1$, are the same in the product and in the polynome. Every descending introduces a variation in the product, instead of a continuation that takes place in the polynome; and although it be supposed that every ascending introduces a continuation in the product instead of a variation that exists in the polynome, yet, on the whole, the variations introduced must be one more than the continuations, because the descendings are one more than the ascendings.

Again, if the given polynome be multiplied by $x+a$, the product will be the sum of these two lines, viz.

$$\left.\begin{array}{l} x^{n+} \pm Ax^n \pm Bx^{n-1} \ldots \pm Mx^2 \pm Nx \\ \quad +axn \pm Aax^{n-1} \qquad \pm Lax^2 \pm Max \pm Na. \end{array}\right\}$$

Here the terms of both lines have the same signs; and, as before, the signs in the product will be the same with the signs of the proposed polynome, unless when a coefficient in the second line is greater than the one above it, and likewise has a contrary sign; the sign of the last term of the product being always the same with the sign of the last term in the second line. Now, if we pass along all the terms of both lines, descending from the first line to the second, when the signs in the product change from being the same with those in the given polynome, to be contrary to them; and ascending from the second line to the first, when the signs in the product change from being contrary to those in the polynome, to be the same with them; it is evident, that the descendings will be one more than the ascendings, as in the former case.

If we descend from $\pm Ax^n$ in the first line, to $\pm Aax^{n-1}$ in the second line, the two terms $\pm Ax^n$

and $\pm Bx^{n-1}$ in the first line, will have different signs; for, on account of the descending, $\pm Bx^{n-1}$ has a contrary sign to the term $\pm Aax^{n-1}$ below it, and, consequently, to $\pm Ax^n$ in the first line. Therefore the second and third terms in the polynome have different signs. But the like terms in the product have the same sign; for the second term in the product has the same sign with $\pm Ax^n$ in the first line; and the third term of the product has the same sign with $\pm Aax^{n-1}$ in the second line. Thus there is a continuation of the same sign introduced in the product, instead of a variation from one sign to another that takes place in the polynome; and the same thing is true at every descending.

In ascending from the second line to the first, there may either be a variation in the product instead of a continuation that exists in the polynome, or the contrary. But one of these two must take place.

Now, it is evident, that, except at the descendings and ascendings, there is the same number of continuations of the same sign, and the same number of variations from one sign to another, in the product and in the given polynome. Every descending introduces a continuation in the product instead of a variation existing in the polynome. And even if we suppose that every ascending introduces a variation in the product instead of a continuation that takes place in the polynome, yet, on the whole, there will be one continuation more in the product than in the polynome, because the descendings are one more than the ascendings.

In the preceding demonstration it is supposed, that all the ascendings have a contrary effect to the descendings, by which means there is introduced in the product the least possible number of variations from one sign to another in the one case, and the least possible number of continuations of the same sign in the other. But if, in the first case, we suppose that, at one ascending, there is a variation in the product, and a continuation in the polynome, this will add one to the variations in the product, and one to the continuations in the polynome; so that, the variations in the product will now exceed those in the polynome by three, namely, by two more than in the circumstances supposed in the demonstration. And if we extend the like reasoning to two, three, &c. ascendings, the variations in the product will exceed those in the polynome, respectively by five, seven, &c. The like conclusion is evidently true of the second case, *mutatis mutandis;* and hence the preceding proposition, when it is generalized as much as it can be, may be thus enunciated: "If any rational polynome be multiplied by $x-a$, the variations from one sign to another in the product will exceed those in the polynome by one, or three, or five, or by some odd number; and if it be multiplied by $x+a$, the continuations of the same sign in the product will exceed those in the polynome by one, or three, or five, or by some odd number."

Now, if we conceive that any rational polynome is resolved into its binomial factors; there will be a factor of the form $x-a$ for every positive root, and one of the form $x+a$ for every negative root; and when all the factors are multiplied together in order to reproduce the polynome, it follows, from what has been proved, that the product will contain at least one change from + to —, or from — to + 1, for every factor of the form $x-a$, or for every positive root; and at least one succession of + to +, or of — to —1, for every factor of the form $x+a$, or for every negative root. Hence this rule, viz. "An equation cannot have more positive roots than it has variations from one sign to another; nor more negative roots than it has continuations of the same sign."

In general, this rule merely points out limits which the number of the positive and negative roots of an equation cannot exceed. But it gives no criterion by which we can certainly know that an equation has even one positive or one negative root, much less does it ascertain the exact number of each kind.

But if the proposed equation can be completely resolved into real binomial factors; in which case the total number of its roots will be equal to its dimensions, and, consequently, to the sum of all the variations from one sign to another, and of all the continuations of the same sign; it is evident, that the number of the positive roots will be precisely equal to that of the variations, and the number of the negative roots precisely equal to that of the continuations. In this case, therefore, and in this case only, the rule of Descartes is perfect, ascertaining the exact number of each kind of roots in the proposed equation.

We subjoin some consequences that result from the principles laid down.

"If a polynome $f(x)$ of n dimensions be multiplied by $x-a$, or $x+a$; and, in the first case, if the number of variations from one sign to another be augmented by the odd number $2i+1$; or, in the second case, if the number of continuations of the same sign be augmented by $2i+1$; then the total number of the roots, positive and negative, of the proposed polynome, cannot be greater than $n-2i$."

For, when the multiplier is $x-a$, let m denote the number of the variations from one sign to another, in the proposed polynome $f(x)$; then $m+2i+1$ will be the total number of variations in the product $(x-a)\times f(x)$: consequently, the total number of continuations in $(x-a)\times f(x)$ will be equal to $(n+1)-(m+2i+1)$, or $n-m-2i$. But a polynome cannot have more negative roots than it has continuations of the same sign; wherefore, the number of the negative roots of $(x-a)\times f(x)$ cannot be greater than $n-m-2i$. Now, the two polynomes $f(x)$ and $(x-a)\times f(x)$ have the same negative roots; and hence the number of the negative roots of $f(x)$ cannot exceed $n-m-2i$. But the number of the positive roots of $f(x)$ cannot exceed m; consequently, the total number of the roots of $f(x)$ cannot be greater than $m+n-m-2i$; that is, than $n-2i$. And the proposition may be demonstrated in a similar manner when the multiplier is $x+a$.

"If one, or several consecutive terms, of an equa-

tion be wanting; and, if the next terms on each side of those wanting have the same sign, the equation cannot have as many roots as it has dimensions."

Let the equation be $P+Q=o$, P and Q denoting the two parts on each side of the terms wanting. Having multiplied $P+Q$ by $x-a$, the product will be $(x-a)P+(x-a)Q$; and it is evident that we may consider P, Q, $(x-a)P$, $(x-a)Q$ as separate polynomes; hence, in each of the polynomes $(x-a)P$ and $(x-a)Q$ there will be at least one more variation from one sign to another, than there is in P and Q. Again, in the polynome $P+Q$, there will be a continuation of the same sign, in passing from P to Q; because the last term of P is supposed to have the same sign with the first term of Q. On the other hand, because the last term of $(x-a)P$ has a contrary sign to the last term of P; and the first term of $(x-a)Q$, the same sign with the first term of Q, it follows that, in the polynome $(x-a)P+(x-a)Q$, there will be a variation from one sign to another, in passing from $(x-a)P$ to $(x-a)Q$. Therefore, on the whole, there will be at least three variations from one sign to another in $(x-a)P+(x-a)Q$, more than there is in $P+Q$: Consequently, by the last proposition, the number of all the roots of the proposed equation must be at least two less than its dimensions.

Number of Real Roots in an Equation.

8. An important inquiry is, to find how many roots, that is, real roots, there are in any proposed equation. Much has been written on this subject, but not very successfully. No general method has been found that is practically useful. Many *criteria* have been contrived, by means of which we can certainly discover that roots are wanting in an equation; although we cannot infer the existence of the roots when the same criteria fail. But great value cannot be attached to such rules; since they are neither sufficient guides in practice, nor have much tendency to throw light on the theory.

Waring first, and nearly about the same time Lagrange, proposed a method which is successful in finding the conditions necessary in order that an equation have as many roots as it has dimensions; and which, in all cases, points out a limit that the number of the roots cannot exceed. This is effected by an auxiliary equation, and merely by the signs of its coefficients, without requiring the computation of any of its roots. This procedure answers very well for equations of the third and fourth degrees; and it has even been extended by Waring to those of the fifth degree; but, in this last case, the calculation is very long, and would be altogether impracticable in the higher orders of equations. It is also not a little probable that this rule employs more conditions than are absolutely necessary for determining the point in question; there being great reason to think that some of them are implied in the rest, and are deducible from them. The method here alluded to depends upon the theory of trinomial divisors; and, as it is much referred to by algebraists of the present day, we shall, in a subsequent part of this article, briefly explain the principles on which it is founded.

There is also another way of finding the number of real roots in an equation, which is general for all orders, and requires the solution of such equations only as are of lower dimensions than the one proposed. As to practical utility, indeed, this method is of little avail in equations passing the third and fourth degrees, or, at most, the fifth degree; but it is, nevertheless, not without interest; both because it is founded on the principles essential to the inquiry, and because it leads to some useful properties. Algebraists differ from one another in their exposition of this method. Some derive it from the theory of Harriot, namely, that every rational polynome is the product of as many binomial factors as it has dimensions; in which manner of proceeding the impossible roots are the occasion of uncertainty and embarrassment. Others, again, deduce it from the variations of magnitude which a rational polynome undergoes when the unknown quantity is made to pass through all possible degrees of increasing and decreasing. This last mode of investigation seems greatly to deserve the preference, being in reality the only one that is entirely unexceptionable, and requires no principles foreign to the research.

Suppose an equation, $x^n+Ax^{n-1}+Bx^{n-2}\ldots\ldots+Mx+N=o$, which we may denote by $f(x)=o$: substitute $x-i$ in place of x, and put

$$X=f(x)=x^n+Ax^{n-1}\ldots\ldots+Mx+N,$$

$$X'=nx^{n-1}+(n-1)Ax^{n-2}+(n-2)Bx^{n-2}\ldots+M,$$

$$X''=n\cdot\frac{n-1}{2}x^{n-2}+n-1\cdot\frac{n-2}{2}Ax^{n-3}+\text{ \&c. \&c.}$$

then the function $f(x-i)$ will be transformed into

$$X-X'\cdot i+X''\cdot i^2-X'''\cdot i^3+\text{ \&c.}$$

If we use the notation of the differential calculus, the same transformation will be thus represented,

$$f(x)-\frac{d\,f(x)}{dx}\cdot i+\frac{1}{2}\cdot\frac{d^2\cdot f(x)}{dx^2}\cdot i^2-\text{ \&c.};$$

which has the advantage of pointing out in what manner the several functions, X′, X″, &c. are derived from one another, and from the first function X, or $f(x)$.

Let α, β, γ, &c. denote the real roots of the equation $X=o$, or $f(x)=o$, arranged according to the order of their magnitude, that is, α greater than β, β greater than γ, and so on. In like manner, observing the same order of arrangement, let α', β', γ', &c. represent the roots of $X'=o$, or $\frac{d.f(x)}{dx}=o$; and for the sake of simplicity, suppose that the equation $X'=o$ has no equal roots.

The relations, which the variations of the polynome X bear to the variations of x, depend upon the functions X′, X″, &c. and principally upon the first of these. If X′ be positive, X will decrease as x decreases; if X′ be negative, X will increase as x decreases; and if X′ pass from being positive to become negative, or the contrary, then x continuing to decrease, X will change from decreasing to increasing, or the contrary; that is, it will attain a minimum or a maximum value. What is here said is the foundation of the method taught in the differential calculus, for finding the maxima and minima of algebraic quantities.

Now, when x has a value great enough, the poly-

nome X′ will have the same sign with its first term, that is, it will be positive; and it will continue positive so long as x is greater than α', the greatest root of the equation $X'=o$; after which it will become negative. Hence, while x decreases to the limit α', the polynome $f(x)$, which is positive when x is sufficiently great, will continually decrease; and when $x=\alpha'$, $f(x)$ will pass from decreasing to increasing, or it will have a minimum value. Now, if this minimum $f(\alpha')$ be positive, $f(x)$ has not decreased to zero, and the given equation will have no root greater than α'. If $f(\alpha')=o$, then, because the two equations, $X=o$ and $X'=o$, take place at the same time, the given equation will have two roots equal to α'. (Sect. 6.) Lastly, if $f(\alpha')$ be negative, the polynome $f(x)$ has decreased from being positive to be negative; and therefore it has passed through zero, and the given equation will have one root, viz. α greater than α'.

As x continues to decrease from α' to β', the polynome X′ being negative, $f(x)$ will continually increase. At the limit $x=\beta'$, X′ is first equal to zero, and then becomes positive; and $f(x)$ will therefore change from increasing to decreasing, or will attain a maximum value. If this maximum $f(\beta')$ be negative, the polynome $f(x)$ has not increased to zero, and the given equation will have no root between α' and β': if $f(\beta')=o$, it will have two roots equal to β': and if $f(\beta')$ be positive, $f(x)$, in increasing from the negative quantity $f(\alpha')$ to the positive quantity $f(\beta')$, must have passed through zero, and the given equation will have one root, viz. β, between α' and β'.

In like manner, x continuing to decrease from β' to γ', the polynome $f(x)$ will decrease from the maximum $f(\beta')$ to the minimum $f(\gamma')$: if $f(\gamma')$ be positive, the proposed equation will have no root between β' and γ'; if $f(\gamma')=o$, it will have two roots equal to γ'; and if $f(\gamma')$ be negative, it will have one root, viz. γ, between the limits β' and γ'.

As the function $f(x)$ must become a minimum or a maximum, or must pass from decreasing to increasing, or the contrary, between every two contiguous roots of the equation $f(x)=o$; and as the limits where the changes take place are determined by the roots of the equation $X'=o$; it follows that there must be at least one root of this last equation between every two contiguous roots of the first. Hence the equation $f(x)=o$ cannot have as many roots as dimensions, unless the equation $X'=o$ likewise have as many roots as dimensions; and, in general, we have this rule, which determines a limit that the number of the roots of an equation cannot surpass, although it may fall short of it: "The roots of an equation $f(x)=o$ cannot exceed in number those of the equation $\frac{d\,f(x)}{dx}=o$, by more than one."

But if we can find the roots of the equation $X'=o$, which is always one degree lower than the proposed equation, we can thence discover exactly both the number and the limits of the roots of this last. For let α', β', γ', &c. be substituted in the polynome $f(x)$, and let the results be arranged in order, viz.

$$\begin{array}{cccc} f(\alpha'), & f(\beta'), & f(\gamma'), & f(\delta'), \text{ \&c.}: \\ - & + & - & + \end{array}$$

if these quantities are alternately negative and positive; the first, third, fifth, &c. which are all minima, having the sign *minus*; and the second, fourth, &c. which are all maxima, having the sign *plus*; then the proposed equation $f(x)=o$ will have just one root more than the equation $X'=o$. When some of the conditions fail, the roots of the proposed equation will fall short of the number specified. If one maximum have the sign *minus*, or one minimum the sign *plus*, two roots will be wanting in the proposed equation; and, in general, as many roots will disappear, as there are consecutive minima and maxima that have the same sign deducting one; unless the minima and maxima precede the greatest root, or come after the least root, in which cases there will be as many roots wanting as there are minima and maxima that have the same sign.

Since the series of functions, X, X′, X″, &c. are derived similarly from one another, we may prove, as has been done with respect to the two first, that the roots of any one are contained between the roots of that which follows it. Hence, if the given equation have as many roots as dimensions, every equation in the series will likewise have as many roots as dimensions; and if there be roots wanting in any one, there will be at least as many wanting in every equation preceding it in the series.

The connected equations necessarily terminate in one of the first degree, which gives a limit between the two roots of the quadratic immediately before it; in like manner, the roots of the quadratic are the limits of the roots of the cubic preceding it; and, in this manner, by going through all the successive equations, we shall finally arrive at the limits of the roots of the proposed equation. This process has been called *La Methode des Cascades*; but the length of the calculations render it useless in practice.

The procedure explained above would enable us to find the number of roots in an equation of any order, if we were in possession of rules for solving equations of the inferior degrees. For want of such rules, the practical advantage that can be derived from it is very limited. Mathematicians have, therefore, turned their attention to determine the point in question in a way that should not require the resolution of equations. They have sought to investigate rational functions of the coefficients, which, by means of the signs they are affected with in every particular case, might indicate the number of roots the equation possesses. Of this nature is the method which *Du Gua* has given in the *Memoires de Paris*, 1741, for finding the conditions necessary in order that an equation have as many roots as dimensions. By a process analogous to that of *Du Gua*, *M. Cauchy*, in an excellent *Memoir*, published in the sixteenth volume of the *Journal de l'Ecole Polytechnique*, has shown not only that the total number of the roots may, in every case, be discovered, but likewise, that the numbers of the positive and negative roots may be separately ascertained. The principles of both these methods are to be found in the theory explained above; but, as many considerations of some intricacy are involved in them, a particular account of them would exceed the limits of this article.

In what goes before, we have supposed that all the roots of the equation $X'=o$ are unequal; and, in order to complete the theory, it remains to notice the consequences that follow when the case is otherwise. Suppose, then, that $X'=(x-\lambda)^i \times Q$: And, in the first place, if λ be a root of the equation $f(x)=o$, there will, in reality, be no exception to the general conclusion; because, in this case, it is known that the polynome $f(x)$ will be divisible by $(x-\lambda)^{i+1}$. (Sect. 6.) Now, the case just mentioned being set aside, if i be an even number, the polynome X', or $(x-\lambda)^i \cdot Q$, will be equal to zero when $x=\lambda$; but it will not change its sign when x, from being less, comes to be greater than λ. Hence the polynome $f(x)$ will neither attain a maximum nor a minimum value at the same limit; and it will have no root, either between λ and the next greater root of the equation $X'=o$, or between λ and the next less root of the same equation. It appears, therefore, that, when i is even, the number of the roots of the equation $f(x)=o$, and their limits, will depend entirely upon the equation $Q=o$. Again, when i is an odd number, the polynome X' will be equal to zero when $x=\lambda$, and it will likewise change its sign when x is taken on contrary sides of that limit: Consequently, when $x=\lambda$, the polynome $f(x)$ will be a maximum or a minimum; and the nature of its roots will depend upon the equation $(x-\lambda)Q=o$. It is evident that we may extend the same conclusions to any two adjacent equations in the series,

$$X=o,\ X'=o,\ X''=o,\ X'''=o,\ \&c.$$

provided the one which stands lower in the series is reducible to the form $(x-\lambda)^i Q$; and that $x-\lambda$ is not a common divisor of both. We may likewise draw this general inference from the principles that have been explained, viz. "If, in the series of connected equations, any one be found which is divisible by $(x-\lambda)^{2i}$, or $(x-\lambda)^{2i+1}$, at the same time that $x-\lambda$ is not a divisor of the equation immediately preceding, there will be at least $2i$ roots wanting in this last equation, and in all that stand before it in the series."

The following not inelegant proposition is a consequence of what has just been proved: "The number of the roots of an equation of n dimensions, in which $2i$ or $2i+1$, consecutive terms, are wanting, cannot be greater than $n-2i$."

Let the equation be represented by

$$P+Q=o;$$

supposing that $2i$, or $2i+1$ terms, are wanting between P and Q. Therefore, if the first term of Q contain x^m, the last term of P will contain x^{m+2i+1}, or x^{m+2i+2}. Now, in the series of equations, we shall at length arrive at one from which all the quantities of Q are exterminated; which equation, if we use the notation of the Differential Calculus, is equivalent to

$$\frac{d^{m+1}P}{dx^{m+1}}=o;$$

and it is divisible by x^{2i}, or x^{2i+1}: And, as the one immediately preceding it in the series, viz.

$$\frac{d^mP}{dx^m}+\frac{d^mQ}{dx^m}=o,$$

is not divisible by x, it follows from what has been shown, that there will be at least $2i$ roots wanting in this last equation, and in all those that stand before it; consequently, the proposed equation cannot have more than $n-2i$ roots.

From this we learn, that it is not always possible, at least by any operations with real quantities, to transform an equation into another in which any proposed number of the intermediate terms shall be wanting. For the terms to be taken away may be such, that the transformed equation could not have the same number of real roots as the one given; but it is impossible, without introducing imaginary quantities, to transform an equation with a certain number of real roots into another with a different number of such roots.

9. In what goes before, we have sought for the roots and binomial divisors in the nature of the polynome. We are now to take an inverted view of the subject, and to consider a rational polynome as produced by the continued multiplication of as many binomial factors as it has dimensions; from which source there arises an interesting set of properties.

If we take the words, root and binomial factor, strictly in the sense in which we have hitherto used them, and as denoting real quantities only, nothing is more certain than that all polynomes cannot be generated by binomial factors. But it will afterwards be proved, that every rational polynome can be completely exhausted by binomial and trinomial divisors; and if we admit the resolution of every trinomial divisor into two imaginary factors, we shall arrive, with all the rigour of which the investigation is capable, at the genesis of equations supposed by Harriot, which represents them as entirely composed of binomial factors, possible or impossible. Besides, in extending to all equations the conclusions obtained from the manner of generating them, it may be observed, that the properties so obtained, being ultimately expressed in functions of the coefficients from which the roots and generating factors have disappeared, are in a manner independent of the method of investigation. Such is the structure of the language of algebra, that the conclusions to which it leads, although deduced by reasoning from a hypothesis not strictly general, are nevertheless true in all cases, when they are finally disengaged from what is peculiar in the analysis.

Suppose a polynome, as

$$x^n-A^{(1)}x^{n-1}+A^{(2)}x^{n-3}\ldots\pm A^{(n-1)}x\mp A^{(n)},$$

which is produced by the multiplication of the n factors,

$$(x-\alpha)\cdot(x-\beta)(x-\gamma)(x-\delta)\ \&c.:$$

then, by actually multiplying the factors, and equating the like terms of the equivalent expressions, we shall get

$$A^{(1)}=\alpha+\beta+\gamma+\delta+\&c.$$

$$A^{(2}=\alpha\beta+\alpha\gamma+\&c.+\beta\gamma+\&c.$$

$A^{(3)}=\alpha\beta\gamma+\alpha\beta\delta+\&c.+\beta\gamma\delta+\&c.$

$A^{(4)}=\alpha\beta\gamma\delta+\&c.$

&c.

Hence, it appears that the coefficient of the second term of the polynome, or $-A^{(1)}$, is equal to the sum of all the roots with their signs changed; the coefficient of the third term, or $+A^{(2)}$, to the sum of all the products of every two roots; the coefficient of the fourth term, or $-A^{(3)}$, to the sum of all the products of every three roots with their signs changed, and so on, the signs of the roots being always changed in the products of an odd number; and, finally, the last term is the product of all the roots with their signs changed or not, according as their number is odd or even.

It is evident, that the ultimate product of the binomial factors will always be the same, in whatever order they are multiplied; and hence the coefficients of the polynome will consist of the same products, however the roots be interchanged among one another. Expressions of the kind just mentioned, which have constantly the same value, whatever change is made in the order of the quantities they contain, are called *invariable functions* and *symmetrical functions*. The coefficients of an equation are the most simple symmetrical functions of the roots, from which it may be required, on the one hand, to deduce all other functions of the like kind, and, on the other, to go back to the roots themselves. Most inquiries relating to equations are connected with one or other of these two problems; of which the first, like most direct methods, is attended with little difficulty, and has been completely solved; while the other, past equations of the fourth degree, has eluded all the attempts of algebraists.

After the coefficients of the polynome, the next most simple symmetrical functions of the roots are the sums of the squares, cubes, &c. In the universal arithmetic of Sir Isaac Newton, a very elegant rule is given for computing the sum of any proposed powers of the roots; and as this rule is a fundamental point in the theory of equations, we subjoin an elementary investigation of it.

Of the binomial factors before set down, let the first $x-\alpha$ be left out, and, having multiplied the rest together, let the product be,

$$x^{n-1}-\varphi^{(1)}x^{n-2}+\varphi^{(2)}x^{n-3}-\varphi^{(3)}x^{n-4}+\&c.;$$

in which expression $\varphi^{(1)}$ is the sum of all the roots β, γ, δ, &c. except the first α; $\varphi^{(2)}$ is the sum of the products of every two of them, and so on. Now, multiply by $x-\alpha$, and the product will be equivalent to the given polynome: hence we get

$$\begin{aligned}
A^{(1)}&=\alpha+\varphi^{(1)}\\
A^{(2)}&=\alpha\,.\,\varphi^{(1)}+\varphi^{(2)}\\
A^{(3)}&=\alpha\,.\,\varphi^{(2)}+\varphi^{(3)}\\
&\vdots\\
A^{(r)}&=\alpha\,.\,\varphi^{(r-1)}+\varphi^{(r)}.
\end{aligned}$$

Again, multiply these formulæ in order by α^{r-1}, α^{r-2}, α^{r-3}, &c.; then

$$\begin{aligned}
\alpha^r&=\alpha^r\\
A^{(1)}\,.\,\alpha^{r-1}&=\alpha^r+\alpha^{r-1}\,.\,\varphi^{(1)}\\
A^{(2)}\,.\,\alpha^{r-2}&=\alpha^{r-1}\,.\,\varphi^{(1)}+\alpha^{r-2}\,.\,\varphi^{(2)}\\
&\vdots\\
A^{(r-1)}\,.\,\alpha&=\alpha^2\varphi^{(r-2)}+\alpha\,.\,\varphi^{(r-1)}\\
A^{(r)}&=\alpha\,.\,\varphi^{(r-1)}+\varphi^{(r)}
\end{aligned}$$

and, by adding and subtracting alternately, we get

$$\alpha^{(r)}-A^{(1)}\,.\,\alpha^{r-1}+A^{(2)}\,.\,\alpha^{r-2}\ldots\pm A^{(r-1)}\,.\,\alpha \mp A^{(r)}=\mp\varphi^{(r)},$$

in which expression $\varphi^{(r)}$ is the sum of all the products of r dimensions of the roots β, γ, δ, &c. leaving out the first α.

In like manner, if we leave out the factor $x-\beta$, and multiply all the rest, and proceed as before, we shall get

$$\beta^r-A^{(1)}\beta^{r-1}+A^{(2)}\beta^{r-2}\ldots\pm A^{(r-1)}\beta\mp A^{(r)}=\pm\varphi'^{(r)},$$

the symbol $\varphi'^{(r)}$ being the sum of the products of r dimensions of all the roots α, γ, δ, except the second β.

And, if we next leave out the factor $x-\gamma$, and follow a like procedure, we shall get

$$\gamma^r-A^{(1)}\,.\,\gamma^{r-1}+A^{(2)}\,.\,\gamma^{r-2}\ldots\pm A^{(r-1)}\,.\,\gamma\mp A^{(r)}=\mp\varphi''^{(r)};$$

where $\varphi''^{(r)}$ represents the sum of the products of r dimensions of all the roots α, β, δ, &c. except the third γ.

If we proceed similarly till every one of the n factors is left out in its turn, and then add all the results, we shall get

$$S_r-A^{(1)}S_{r-1}+A^{(2)}S_{r-2}\ldots\pm A^{(r-1)}S_1\,.\mp nA^{(r)}=\mp\left\{\varphi^{(r)}+\varphi'^{(r)}+\varphi''^{(r)}+\&c.\right\};$$

in which expression S_r is written for the sum of the r powers of the roots; S_{r-1}, for the sum of the $(r-1)$ powers, and so on.

Every product in any one of the aggregate quantities, $\varphi^{(r)}$, $\varphi'^{(r)}$, $\varphi''^{(r)}$, &c., is found in $A^{(r)}$, which is the sum of the products of r dimensions of all the roots: and, hence, it is easy to perceive that the sum of all the aggregates must be a multiple of $A^{(r)}$. Take any product in $A^{(r)}$: then that product will not be contained in r of the quantities $\varphi^{(r)}$, $\varphi'^{(r)}$, $\varphi''^{(r)}$, &c.; because, in so many of them, one or other of the letters of the product

will be wanting; but the same product will be contained once in every one of the $n-r$ remaining quantities, because, in every one of these, all the letters of the product will be contained. Every product in $A^{(r)}$ is, therefore, repeated $n-r$ times in the sum of the quantities $\varphi^{(r)}$, $\varphi'^{(r)}$, $\varphi''^{(r)}$, &c.: consequently,

$$\varphi^{(r)}+\varphi'^{(r)}+''^{(r)}+\text{ \&c. }=(n-r)A^{(r)}.$$

Substitute this value in the formula obtained above, and, after transposing and cancelling $nA^{(r)}$, which appears with contrary signs, we shall get

$$S_r-A^{(1)}S_{r-1}+A^{(2)}S_{r-2}\ \ldots\ \pm A^{r-1}S$$
$$\mp rA^{(r)}=o.$$

This is the rule of Sir Isaac Newton, and contains all his particular formulæ, as will readily appear by putting 1, 2, 3, &c. successively for r.

The preceding formula will enable us to compute, in succession, the sums of all the positive powers of the roots, both when r is less, and when it is greater than the dimensions of the equation. But, in applying the formula in the latter case, we must observe that all the coefficients of the polynome after $A^{(r)}$ are wanting, or equal to nothing.

If, in the first step of the preceding investigation, we take the coefficients that follow $A^{(r)}$, we shall get

$$A^{(r+1)}=\alpha\,.\,\varphi^{(r)}+\varphi^{(r+1)}$$
$$A^{(r+2)}=\alpha\,.\,\varphi^{(r+1)}+\varphi^{(r+2)}$$
$$\vdots$$
$$A^{(n-1)}=\alpha\varphi^{(n-2)}+\varphi^{(n-1)}$$
$$A^{(n)}=\alpha\,.\,\varphi^{(n-1)}:$$

And, by first dividing by α, α^2, α^3, &c. in order, and then subtracting and adding alternately, we shall obtain

$$\frac{A^{(r+1)}}{\alpha}-\frac{A^{(r+2)}}{\alpha^2}+\frac{A^{(r+3)}}{\alpha^3}-\text{\&c.}=\varphi^{(r)}.$$

In a similar manner, we get

$$\frac{A^{(r+1)}}{\beta}-\frac{A^{(r+2)}}{\beta^2}+\frac{A^{(r+3)}}{\beta^3}-\text{\&c.}=\varphi'^{(r)}$$
$$\frac{A^{(r+1)}}{\gamma}-\frac{A^{(r+2)}}{\gamma^2}+\frac{A^{(r+3)}}{\gamma^3}-\text{\&c.}=\varphi''^{(r)}\quad\text{\&c.}$$

Therefore, by adding all these formulæ, and substituting for the sum of $\varphi(r)$, $\varphi'^{(r)}$, &c. the value of it already found, we shall finally obtain

$$A^{(r+1)}S_{-1}-A^{(r+2)}S_{-2}+A^{(r+3)}S_{-3}-\text{\&c.}$$
$$=(n-r)A^{(r)},$$

the symbols S_{-1}, S_{-2}, &c. being put for the sums of the negative powers of the roots according to the indices underwritten. This formula will enable us to compute the sums of the negative powers of the roots.

If, in the formula for the sums of the positive powers of the roots, we make r successively equal to 1, 2, 3, &c. we shall get

$$A^{(1)}=S_1$$
$$-2A^{(2)}=-A^{(1)}S_1+S_2$$
$$3A^{(3)}=A^{(2)}S_1-A^{(1)}S_2+S_3$$
$$-4A^{(4)}=-A^{(3)}S_1+A^{(2)}S_2-A^{(1)}S_3+S_4$$
&c.

and from this we learn that the quantities S_1, S_2, S_3, &c. may be found by means of this expression, viz.

$$\frac{A^{(1)}-2A^{(2)}z+3A^{(3)}z^2\ldots\pm A^{(n)}z^{n-1}}{1-A^{(1)}z+A^{(2)}z^2\ldots\pm A^{(n)}z^n}=S_1+S_2\,.\,z+S_3\,.\,z^2+\text{\&c.}$$

for if we multiply the series on the right-hand side of the sign of equality, by the denominator of the fraction on the other side, and then equate the coefficients of the product to the like coefficients of the numerator, we shall obtain the very formulæ set down above. Hence the sums of the powers of the roots expressed in terms of the coefficients of the polynome, will be found by developing the fraction in a series. In effecting the developement different analytical methods may be followed; and the quantities sought will thus be obtained by different rules, or exhibited in expressions of different forms, such as those given by Waring, Vandermonde, Euler, and La Grange.

And in like manner if, in the formula for the sums of the negative powers of the roots, we make r successively equal to $n-1$, $n-2$, $n-3$, &c. we shall get

$$A^{(n-1)}=A^{(n)}S_{-1}$$
$$-2A^{(n-2)}=-A^{(n-1)}S_{-1}+A^{(n)}S_{-2}$$
$$3A^{(n-3)}=A^{(n-2)}S_{-1}-A^{(n-1)}S_{-2}+A^{(n)}S_{-3}$$
$$-4A^{(n-4)}=-A^{(n-3)}S_{-1}+A^{(n-2)}S_{-2}$$
$$-A^{(n-1)}S_{-3}+A^{(n)}S_{-4},$$
&c.

from which it appears that the values of all the quantities S_{-1}, S_{-2}, S_{-3}, &c. will be obtained by means of this expression, viz.

$$\frac{A^{(n-1)}-2A^{(n-2)}z+3A^{(n-3)}z^2-\text{\&c.}}{A^{(n)}-A^{(n-1)}z+A^{(n-2)}z^2-\text{\&c.}}=S_{-1}+S_{-2}.z+S_{-3}.z^2+4.$$

Two kinds of quantities only can enter into any rational and symmetrical function of the roots of an equation; and these are, the sums of the like powers of the roots, and the sums of such products as, $\alpha^i\beta^{i'}\gamma^{i''}$ &c. which arise from multiplying different powers of the roots, two and two, three and three, &c. We shall now shortly point out in what manner the latter sums are deduced from the sums of the like powers, for the computation of which rules have already been given; by which means we shall be enabled to find the value of any proposed function of the kind above mentioned.

Let it be required to find the sum of all the products, such as $\alpha^i\beta^{i'}$, that arise from combining two powers of the roots in all possible ways; which sum may be denoted by the symbol $\Sigma.\alpha^i\beta^{i'}$. Now it is evident that the product, $S_i \times S_{i'}$, will contain two sorts of terms only, namely, powers of the roots, such as $\alpha^{i+i'}$, and the products of which the sum is sought; therefore

$$\Sigma.\alpha^i\beta^{i'} = S_i \times S_{i'} - S_{i+i'}.$$

Next let it be required to find $\Sigma.\alpha^i\beta^{i'}\gamma^{i''}$, or the sum of all the products of three powers of the root. Now $\Sigma.\alpha^i\beta^{i'} \times S_{i''}$ will contain three sorts of terms, namely, products, such as $\alpha^{i+i''}\beta^{i'}$ and $\alpha^{i'+i''}\beta^i$, in which two roots only are combined, and the products of which the sum is required; therefore

$$\begin{aligned}\Sigma.\alpha^i\beta^{i'}\gamma^{i''} = &\Sigma.\alpha^i\beta^{i'} \times S_{i''} \\ &-\Sigma.\alpha^{i+i''}\beta^{i'} \\ &-\Sigma.\alpha^{i'+i''}\beta^i:\end{aligned}$$

but, according to the last case,

$$\Sigma.\alpha^{i+i''}\beta^{i'} = S_{i+i''} \times S_{i'} - S_{i+i'+i''}$$

$$\Sigma.\alpha^{i'+i''}\beta^{i} = S_{i'+i''} \times S_{i} - S_{i+i'+i''}:$$

wherefore

$$\begin{aligned}\Sigma.\alpha^i\beta^{i'}\gamma^{i''} = &S_i \times S_{i'} \times S_{i''} \\ &-S_{i+i'} \times S_{i''} \\ &-S_{i+i''} \times S_{i'} \\ &-S_{i'+i''} \times S_i \\ &+2S_{i+i'+i''}\end{aligned}$$

In like manner, when four different powers of the roots are multiplied together, we get

$$\begin{aligned}\Sigma.\alpha\beta^i\beta^i\gamma^{i''}\delta^{i'''} = &\Sigma.\alpha^{i'}\beta^{i'}\gamma^{i''} \times S_{i'''} \\ &-\Sigma.\alpha^{i+i'''}\beta^{i'}\gamma^{i''} \\ &-\Sigma.\alpha^{i'+i'''}\beta^i\gamma^{i''} \\ &-\Sigma.\alpha^{i''+i'''}\beta^{i'}\gamma^i:\end{aligned}$$

and we have only to apply the preceding case, in order to obtain the expression of the quantity sought in terms of the sums of the like powers of the roots.

According to the procedure just explained, the case where any number of powers are multiplied together, is reduced to the simpler case where the powers multiplied are one less. There would be no great difficulty in deducing a general formula for the sum when the products contain any proposed number of different powers; but this would lead to calculations incompatible with the length of this article; and it may be doubted, whether the use of such a formula is preferable in any cases likely to occur in practice, to the application of the principles here laid down.

The theory of symmetrical functions is of the most extensive use in every branch of the doctrine of equations. Thus, if it be required to form an equation, the roots of which shall be any combinations of the roots of a given equation; it is manifest, that the coefficients of the equation sought will be symmetrical functions of the roots of the given equation; and hence they may be found, by calculating these functions in terms of the coefficients of the given equation.

The theory of symmetrical functions is also of use in approximating to the roots of numerical equations. Sir Isaac Newton seems to have had this application in view, in giving his rule for computing the sums of the like powers of the roots. He observes, that the powers of a great number increase in a much higher ratio than the same powers of less numbers; and hence, the $2r^{\text{th}}$ power of the greatest root of an equation will approach nearer to the sum of the $2r^{\text{th}}$ powers of all the roots, as r is greater. Wherefore, neglecting the distinction between positive and negative roots, if we calculate S_{2r}, and then extract its $2r^{\text{th}}$ root, we shall have an approximation to the root of the equation greatest in point of magnitude; and the approximation will be so much more accurate as r is greater.

But there is a more convenient way of approximating to the greatest and least roots of an equation, by means of symmetrical functions. For, since

$$S_{r+1} = \alpha^{r+1} + \beta^{r+1} + \&c.$$

$$S_r = \alpha^r + \beta^r + \&c.$$

we have

$$\frac{S_{r+1}}{S_r} = \alpha.\frac{1 + \dfrac{\beta^{r+1}}{\alpha^{r+1}} + \&c.}{1 + \dfrac{\beta^r}{\alpha^r} + \&c.};$$

Now, α being the greatest root, the fraction on the right-hand side will approach to unit when r is sufficiently large, in which case $\frac{S_{r+1}}{S_r}$ will be nearly equal to α. Hence, if we compute a series of consecutive sums, viz. S_r, S_{r+1}, S_{r+2}, &c.; the values

$$\frac{S_{r+1}}{S_r},\ \frac{S_{r+2}}{S_{r+1}},\ \frac{S_{r+3}}{S_{r+2}},\ \&c.$$

will approach nearer and nearer to the greatest root of the equation.

In like manner, if we take the sums of the negative powers of the roots, we shall have

$$\frac{S_{-r}}{S_{-r-1}} = \alpha.\frac{1 + \dfrac{\alpha^r}{\beta^r} + \&c.}{1 + \dfrac{\alpha^{r+1}}{\beta^{r+1}} + \&c.};$$

from which it appears that $\frac{S_{-r}}{S_{-r-1}}$ will approximate so much more to α, the least root of the equation, as r is greater.

Trinomial Divisors.

10. We proceed next to consider the trinomial divisors of a given polynome; and, in order to avoid reference to other treatises, we shall begin with a short investigation of a preliminary point.

We have this identical expression,

$$x^2-y^2=(x+y)\,.\,(x-y);$$

consequently,

$$(x^2-y^2)^n=(x+y)^n\,.\,(x-y)^n;$$

and, again,

$$(x^2-y^2)^n=\frac{1}{4}\cdot\left\{(x+y)^n+(x-y)^n\right\}^2$$
$$-\frac{1}{4}\cdot\left\{(x+y)^n-(x-y)^n\right\}^2.$$

Now, using the letters H and G as the characteristics of the particular functions under consideration, let

$$H_n(x,y^2)=\frac{1}{2}\cdot\left\{(x+y)^n+(x-y)^n\right\}$$

$$G_n(x,y^2)=\frac{1}{2}\cdot\frac{(x+y)^n-(x-y)^n}{y};$$

or, by expanding the binomial quantities in series,

$$H_n(x,y^2)=x^n+n.\frac{n-1}{2}.x^{n-2}y^2+\ \&c.$$

$$G_n(x,y^2)=nx^{n-1}+n.\frac{n-1}{2}.\frac{n-2}{3}x^{n-3}y^2+\&c.;$$

then, by means of these notations, the preceding expression will be thus written, viz.

$$(x^2-y^2)^n=\left\{H_n(x,y^2)\right\}^2-y^2.\left\{G_n(x,y^2)\right\}^2.$$

This equation is identical; that is, when the expressions on both sides of the sign of equality are expanded in series of terms containing the powers of y^2, they will consist of the same quantities with the same signs. It is evident, therefore, that the equation will still be identical, if we change y^2 into $-y^2$: for, by this change, the simple quantities of the developed expressions will not be affected; and no alteration will be produced, except in the signs of the odd powers of y^2, which will now be contrary to what they were before. We therefore have

$$(x^2+y^2)^n=\left\{H_n(x,-y^2)\right\}^2+y^2.\left\{G_n(x,-y^2)\right\}^2:$$

in which equation it is to be observed that the functional expressions are not, as in the former instance, susceptible of an abridged algebraic notation, at least without introducing a new sign; but they can be exhibited in series, viz.

$$H_n(x,-y^2)=x^n-n.\frac{n-1}{2}.x^{n-2}y^2+$$
$$n.\frac{n-1\,.\,n-2\,.\,n-3}{2\ .\ 3\ .\ 4}x^{n-4}y^2-\&c.$$

$$G_n(x,-y^2)=nx^{n-1}-n.\frac{n-1\,.\,n-2}{2\ .\ 3}x^{n-3}y^2+\&c.$$

Now put $x=r\cos\varphi$, $y=r\sin\varphi$, $x^2+y^2=r^2$; and let $\varphi^{(n)}$ denote an arc, depending, in a certain manner, not yet discovered, upon the arc φ and the index n; then, in consequence of the equation obtained above, we shall have

$$r^n\cos\varphi^{(n)}=H_n(x,-y^2)$$
$$r^n\sin\varphi^{(n)}=yG^n(x,-y^2).$$

Again, multiply both sides of the same equation last referred to by x^2+y^2; then

$$(x^2+y^2)^{n+1}=\left\{x\,.\,H_n(x,-y^2)-y^2G_n(x,-y^2)\right\}^2$$
$$+y^2\left\{H_n(x,-y^2)+xG_n(x,-y^2)\right\}^2$$

but, since the equation alluded to is general for all the values of n, we may write $n+1$ for n; and thus we get

$$(x^2+y^2)^{n+1}=\left\{H_{n+1}(x,-y^2)\right\}^2+$$
$$y^2\left\{G_{n+1}(x,-y^2)\right\}^2:$$

therefore, by comparing the two values of $(x^2+y^2)^{n+1}$,

$$H_{n+1}(x,-y^2)=x\,.\,H_n(x,-y^2)-y^2G(x,-y^2)$$
$$yG_{n+1}(x,-y^2)=yH_n(x,-y^2)+yxGn(x,-y^2):$$

and finally, by substituting the values of the functions in terms of the arcs, φ, $\varphi^{(n)}$, $\varphi^{(n+1)}$, we shall obtain

$$\cos\varphi^{n+1}=\cos\varphi\cos\varphi^{(n)}-\sin\varphi\sin\varphi^{(n)}=\cos(\varphi^{(n)}+\varphi)$$
$$\sin\varphi^{n+1}=\cos\varphi\sin\varphi^{(n)}+\sin\varphi\cos\varphi^{(n)}=\sin(\varphi^{(n)}+\varphi)$$
$$\varphi^{(n+1)}=\varphi^{(n)}+\varphi.$$

Now, if we make n successively equal to 1, 2, 3, &c. the results will be,

$$\varphi^{(2)}=2\varphi$$
$$\varphi^{(3)}=3\varphi$$
&c.

and generally, $\varphi^{(n)}=n\varphi$.

Thus it appears that

$$r^n\cos n\varphi=H_n(x,-y^2)$$

$$r^{n-1}\times\frac{\sin n\varphi}{\sin\varphi}=G_n(x,-y^2);$$

or, if we take the expanded expressions of the functions,

$$r^n\cos n\varphi=x^n-n.\frac{n-1}{2}x^{n-2}y^2+$$
$$n.\frac{n-1\,.\,n-2\,.\,n-3}{2\ .\ 3\ .\ 4}x^{n-4}y^2-\ \&c.$$

$$r^{n-1}\times\frac{\sin n\varphi}{\sin\varphi}=nx^{n-1}-n.\frac{n-1\,.\,n-2}{2\ .\ 3}x^{n-3}y^2+\&c.$$

in which formulæ, $x=r\cos\varphi$, $y=r\sin\varphi$.

The functions here designated by the letters H and G may be expressed by means of the imaginary sign; for we have

$$H_n(x,-y^2)=\frac{(x+y\sqrt{-1})^n+(x-y\sqrt{-1})^n}{2}$$

$$G_n(x, -y^2) = \frac{(x+y\sqrt{-1})^n - (x-y\sqrt{-1})^n}{2y\sqrt{-1}}:$$

And, in the case of $r=1$, the formulæ obtained above are equivalent to the expressions known in analysis since the time of Dr Moivre, viz.

$$\text{Cos}\, n\varphi = \frac{(\cos\varphi + \sin\varphi\sqrt{-1})^n + (\cos\varphi - \sin\varphi\sqrt{-1})^n}{2}$$

$$\text{Sin}\, n\varphi = \frac{(\cos\varphi + \sin\varphi\sqrt{-1})^n - (\cos\varphi - \sin\varphi\sqrt{-1})^n}{2\sqrt{-1}}.$$

But the mode of investigation we have followed is rigorous; and it has the advantage of leading to the true import of the imaginary sign, and of putting in a clear light its real effect in analytical operations. The real use of this sign may be shortly described by saying that it performs for even and odd functions the same office that the negative sign does for ordinary functions; in other words, when, by means of the ordinary operations of analysis, it has been proved that an even or odd function of an indeterminate quantity is equal to zero, it is by means of the impossible sign that the same equation is extended to the case when the square of the indeterminate quantity is negative. Every function of the indeterminate quantity x may be thus represented, viz.

$$\varphi(x^2) \pm x\Psi(x^2);$$

and the substitution of $x\sqrt{-1}$ in place of x, has no other effect than to change the preceding expression into the one following, viz.

$$\varphi(-x^2) \pm x\sqrt{-1} \cdot \Psi(-x^2):$$

and from this it is obvious, that the same operations which, in the one case, lead us to the equations $\varphi(x^2)=o$ and $x\Psi(x^2)=o$, will, in the other, necessarily conduct us to the equations $\varphi(-x^2)=o$ and $x.\Psi(-x^2)=o$. It is to be observed, too, that the truth of the two latter equations is involved in that of the former. For the former equations cannot be generally true for all values of x^2, unless they are identical, or consist of equal quantities with opposite signs that mutually destroy one another; in which case the latter equations will also be identical. The sign of impossibility, as it has been called, is, therefore, one as truly significant as any other in analysis. It has, indeed, no consistent meaning when we consider it as only affecting x, or the indeterminate quantity to which it is joined; but it becomes perfectly intelligible when we contemplate the real changes produced by it in the functions of even and odd dimensions, in which its conclusions are always ultimately expressed. When the true import and real effect of the imaginary sign are clearly apprehended, the truth of its conclusion is no longer doubtful or mysterious, but follows as a necessary consequence of a fundamental principle of analytical language. Proceeding on this principle we may even lay aside the imaginary character; and, in every particular case, with the assistance of a proper notation, arrive, by the ordinary operations, at the same conclusion to which it leads, as has been done in the preceding instance. It is to be observed further, that the imaginary arithmetic is not merely a short method of calculation convenient in practice, and that may be dispensed with; it is strictly a necessary branch of analysis, without which, or some equivalent mode of investigation, that science would be extremely imperfect. The equations $\varphi(x^2)=o$ and $x\Psi(x^2)=o$, are unchangeable by any operations with the signs commonly received, by the use of which alone it is impossible to deduce, in a direct manner, the related equations $\varphi(-x^2)=o$ and $x\Psi(-x^2)=o$: although the latter are equally true, of as frequent occurrence, and as extensive application, as the former. Without the impossible sign the operations of algebra would, therefore, be defective; since there are analytical truths that could not be investigated in a direct manner by means of the elementary signs usually admitted. It is to supply this defect that the Imaginary Arithmetic has been introduced, and has grown up to be an extensive branch of analysis; advancing at first by slow steps, because the true import of the character it employs, and the real effect of its operations, were neither clearly perceived nor fully understood. But, having premised what is conducive to our present purpose, we proceed to the investigation of the trinomial divisors of rational functions.

11. Every polynome of odd dimensions, having at least one binomial factor, it may, by dividing by that factor, be reduced to another polynome one degree lower. And hence, in this part of our subject, we may confine our attention to polynomes of even dimensions. We may also suppose that the even polynomes, under consideration have no double, triple, &c. factors of any kind; since, in case any such are present, they can be found separately and eliminated by division.

Suppose, then, that $f(x)$ represents any polynome of even dimensions; let $\varrho - u$ be substituted in place of x; and, by using the notation of the differential calculus, the given polynome will be transformed into

$$f(\varrho) + \frac{d.f(\varrho)}{d\varrho} \cdot u + \frac{1}{2} \cdot \frac{d^2 f(\varrho)}{d\varrho^2} \cdot u^2 + \text{\&c.}$$

Since $f(x)$ is an even polynome, the equation $\frac{df(x)}{dx}=o$ will be one of odd dimensions, having at least one root. Let ϱ be the sole root of $\frac{df(x)}{dx}=o$, when it has but one; and the greatest root, when it has several; then, because $\frac{df(\varrho)}{d\varrho}=o$, the transformed function will become

$$f(\varrho) + \frac{1}{2} \cdot \frac{d^2 f(\varrho)}{d\varrho^2} u^2 + \frac{1}{6} \cdot \frac{d^3 f(\varrho)}{d\varrho^3} \cdot u^3 + \text{\&c.}$$

It readily appears, from what was formerly proved (Sect. 8), that ϱ, the greatest root of $\frac{df(x)}{dx}=o$, exceeds the greatest root of any of the equations, $\frac{1}{2} \cdot \frac{d^2 f(x)}{dx^2} = o$, $\frac{1}{6} \cdot \frac{d^3 f(x)}{dx^3} = o$, &c.: and, because, in any equation, the substitution of a value greater than the greatest root must give a positive

result, all the quantities $\frac{1}{2}\cdot\frac{d^2f(\varrho)}{d\varrho^2}, \frac{1}{6}\cdot\frac{d^3f(\varrho)}{d\varrho^3}$, &c. will be positive. With regard to $f(\varrho)$ it may be either positive or negative, but not equal to zero; since this last case can happen only when the polynome has equal roots. The original polynome will, therefore, assume this form, viz.

$\mp y + A^{(2)}u^2 + A^{(3)}u^3 + A^{(4)}u^4 \ldots + A^{(2n-1)}u^{2n-1} + u^{2n}$, in which expression y, $A^{(2)}$, $A^{(3)}$, &c. represent any positive quantities.

The most interesting proposition in the branch of the subject under consideration, is to prove that every polynome of even dimensions has a quadratic divisor, either of the form $(u+\alpha)^2-\tau^2$, which admits two real binomial factors, or of the form $(u-\alpha)^2+\tau^2$, which has two imaginary factors. By the preceding transformation this proposition is brought under two cases, according as y is affected with the sign *minus* or *plus*; the quadratic divisor being always of the form $(u+\alpha)^2-\tau^2$ in the first case; and always of the form $(u-\alpha)^2+\tau^2$ in the other case; a distinction that agrees with what was before proved, Sect. 8.

Now the first of these cases is attended with no difficulty. For two values of u, one negative and one positive, may be found that will satisfy the equation, Sect. 4.

$$y = A^{(2)}u^2 + A^{(3)}u^3 + A^{(4)}u^4 \ldots + u^{2n}.$$

Of these values, it is obvious that the negative one will be always greater than the positive one; and they may, therefore, be represented by $-(\tau+\alpha)$ and $\tau-\alpha$: wherefore, the polynome

$$-y + Au^2 + A^{(3)}u^3 + A^{(4)}u^4 \ldots + u^{2n},$$

will be divisible by each of the binomial factors,

$$u+\tau+\alpha$$
$$u-\tau+\alpha;$$

and likewise by the quadratic factor,

$$(u+\alpha)^2-\tau^2,$$

produced by their multiplication.

But the same mode of reasoning will not apply when y has the sign *plus*; in which case the demonstration must be deduced from other principles.

12. If we put

$$\varphi(u) = A^{(2)}u^2 + A^{(3)}u^3 + A^{(4)}u^4 \ldots + u^{2n},$$

the transformed polynome, supposing y to have the sign *plus*, will become

$$y+\varphi(u).$$

Let $(u-\alpha)^2+\tau^2$ be a quadratic divisor of this polynome, and put $u-\alpha=z$, or $u=\alpha+z$; then, by substituting $\alpha+z$ for u, and writing all the terms of the transformed function $\varphi(\alpha+z)$ in two lines, one containing all the even, and the other all the odd, powers of z; the polynome $y+\varphi(u)$ will be equal to

$$y+\varphi(\alpha)+\frac{1}{2}\cdot\frac{d^2\varphi(\alpha)}{d\alpha^2}\cdot z^2+\frac{1}{24}\cdot\frac{d^4\varphi(\alpha)}{d\alpha^4}z^4+\&c.$$

$$+z\cdot\left\{\frac{d\varphi(\alpha)}{da}+\frac{1}{6}\cdot\frac{d^3\varphi(\alpha)}{d\alpha^3}\cdot z^2+\&c.\right\}.$$

By the same substitution of z for $u-a$, the divisor $(u-\alpha)^2+\tau^2$ is changed into the binomial quantity $z^2+\tau^2$; which will be a divisor of each of the preceding lines, if $-\tau^2$, when it is substituted for z^2, render each of them equal to zero, Sect. 3. Hence we obtain the two following equations, viz.

$$o=y+\varphi(\alpha)-\frac{1}{2}\cdot\frac{d^2\varphi(\alpha)}{d\alpha^2}\tau^2+\frac{1}{24}\cdot\frac{d^4\varphi(\alpha)}{d\alpha^4}\tau^4-\&c.$$

$$o=\frac{d\varphi(\alpha)}{da}-\frac{1}{6}\cdot\frac{d^3\varphi(\alpha)}{da^3}\tau^2+\&c. \qquad \text{(C)}$$

If two numbers, α and τ^2, can be found that will satisfy these equations, it is evident that $z^2+\tau^2$ will be a divisor of each of the two lines that compose the transformed function $y+\varphi(\alpha+z)$; consequently, it will be a divisor of the sum of both lines, or of the function itself; that is, $(u-a)^2+\tau^2$ will be a divisor of the proposed polynome $y+\varphi(u)$. We are now to prove that two such numbers may be found.

Substitute $\lambda^2\alpha^2-s$ for τ^2 in the equations (C), λ being a quantity to be afterwards determined; and, in order to shorten expressions, put

$$M=\varphi(\alpha)-\frac{1}{2}\cdot\frac{d^2\varphi(a)}{da^2}(\lambda^2\alpha^2-s)+\frac{1}{24}\cdot\frac{d^4\varphi(a)}{da^4}+ (\lambda^2\alpha^2-s)^2-\&c.$$

$$N=\frac{d\varphi(\alpha)}{da}-\frac{1}{6}\cdot\frac{d^3\varphi(\alpha)}{d\alpha^3}(\lambda^2\alpha^2-s)+\&c.$$

And the two equations (C) will be thus written, viz.

$$y+M=o$$
$$N=o.$$

In these equations α and s are always supposed to represent positive numbers, in which case the equation $N=o$ cannot take place when s is greater than $\lambda^2\alpha^2$; for then all the terms of N would be positive.

Considering N as a function of α, the part of it that does not contain α is evidently

$$A^{(3)}s + A^{(5)}s^2 + A^{(7)}s^3 + \&c.$$

which is always positive. The highest power of α contained in the same function is α^{2n-1}; and we shall obtain all the terms of N that contain this power by putting α^{2n} for $\varphi(\alpha)$ in the expression,

$$\frac{d\varphi(\alpha)}{da}-\frac{1}{6}\cdot\frac{d^3\varphi(\alpha)}{da^3}\lambda^2\alpha+\frac{1}{120}\cdot\frac{d^5\varphi(\alpha)}{da^5}\lambda^4\alpha^4-\&c.;$$

which terms are therefore as follows, viz.

$$\alpha^{2n-1}\cdot\left\{2n-2n.\frac{2n-1.2n-2}{2\ .\ 3}\lambda^2+2n.\right.$$

$$\left.\frac{2n-1.2n-2.2n-3.2n-4}{2\ .\ 3\ .\ 4\ .\ 5}\lambda^4+\&c.\right\}$$

Now, in the expression obtained in Sect. 10, viz.

$$r^{2n-1}\times\frac{\sin 2n\varphi}{\sin\varphi}=2nx^{2n-1}-2n.\frac{2n-1.2n-2}{2\ .\ 3}$$

$$x^{2n-3}y^2+\&c.$$

if we put $\lambda^2=\frac{y^2}{x^2}=\tan.^2\varphi$, and divide both sides by $x^{2n-1}=r^{2n-1}\cos^{2n-1}\varphi$; we shall obtain

$$\frac{\sin 2n\phi}{\sin\phi}\times\frac{1}{\cos^{2n-1}\phi}=2n-2n.\frac{2n-1.2n-2}{2\ .\ 3}\lambda^2+\ \&c.;$$

from which formula it follows, that the polynome on the right-hand side of the sign of equality will be equal to nothing, where $\phi=\pm\frac{m}{n}\times 90^0$, m being any integer number less than n, zero not included. Wherefore the first, third, &c. roots of the polynome will be expressed by the formula

$$\lambda^2=\tan.^2\frac{2k+1}{n}.90^0,$$

$2k+1$ representing any odd number less than n; and the second, fourth, &c. roots by the formula

$$\lambda^2=\tan.^2\frac{2k+2}{n}.90^0,$$

$2k+2$ being any even number less than n. And it is evident that the polynome will be negative for every value of λ^2 that lies between any odd root and the next even root, that is, for every value between these limits, viz.

$$\lambda^2>\tan.^2\frac{2k+1}{n}.90^0$$

$$\lambda^2<\tan.^2\frac{2k+2}{n}.90^0.$$

Thus, an indefinite number of values of λ^2 may be found that will make the polynome negative.

Having assumed such a value of λ^2, let any positive number whatever be substituted for s, and N will be converted into a rational function of α; the greatest power of α, or α^{2n-1}, being odd, and having a negative coefficient; and the term which does not contain α being positive. Wherefore, at least, one positive value of α may be found that will satisfy the equation $N=o$; and, as has already been observed, this value of α will be such as to make $\lambda^2\alpha^2-s$ a positive quantity. It is possible indeed that, in the equation $N=o$, there may be several values of α for every assumed value of s; but we here confine our attention to the least positive value, which is distinguished by this circumstance, that it vanishes with the absolute term of the equation, or with s; whereas, when s is equal to zero, all the other roots of the equation $N=o$ have finite values depending upon the given coefficients.

Now, if we suppose s to increase from zero to infinity, and assume two values, s and $s+\delta s$, very near one another, according to what has been proved, we shall have the corresponding values, α and $\alpha+\delta\alpha$, such, that the equation $N=o$ will be satisfied by substituting both s and α, and likewise $s+\delta s$ and $a+\delta\alpha$. Hence, because $N=o$, and $\delta N=o$, we get

$$\frac{dN}{da}.\delta\alpha+\frac{dN}{\alpha s}.\delta s=o$$

$$\text{and, } \delta\alpha=-\frac{\delta s}{\left(\frac{dN}{da}\right)}\times\frac{dN}{ds}.$$

Again, if we substitute first s and α, and then $s+\delta s$ and $\alpha+\delta\alpha$, in the function M, we shall get

$$\delta M=\frac{dM}{d\alpha}.\delta\alpha+\frac{dM}{ds}.\delta s.$$

But, by comparing the functions M and N, the following properties will readily be discovered, viz.

$$\frac{dM}{da}+2\lambda^2\alpha.\frac{dM}{ds}=N-2\frac{dN}{ds}(\lambda^2\alpha^2-s)$$

$$\frac{dM}{ds}=\frac{1}{2}.\frac{dN}{da}+\lambda^2\alpha.\frac{dN}{ds}:$$

whence,

$$\frac{dM}{da}=N-2\frac{dN}{ds}(\lambda^2\alpha^2-s)-\frac{dN}{da}\lambda^2\alpha-2\lambda^4\alpha^2\frac{dN}{ds}.$$

Consequently,

$$\delta M=\left\{N-2\frac{dN}{ds}(\lambda^2\alpha^2-s)-\frac{dN}{da}\lambda^2\alpha-2\lambda^4\alpha^2.\frac{dN}{ds}\right\}$$

$$+\delta\alpha+\left\{\frac{1}{2}.\frac{dN}{da}+\lambda^2\alpha.\frac{dN}{ds}\right\}.\delta s:$$

and, if we observe that $N=o$, and substitute the value of δa found above, we shall get

$$\delta M=\frac{-\delta s}{\left(\frac{dN}{d\alpha}\right)}.\left\{2\left(\frac{dN}{ds}\right)^2(\lambda^2\alpha^2-s)+\frac{1}{2}\left(\frac{dN}{da}+2\lambda^2\alpha\frac{dN}{ds}\right)^2\right\}$$

in which expression all the quantities are essentially positive, except $\frac{dN}{da}$, which is always negative, as may be thus proved.

The quantity s remaining invariable, if we make $\alpha=o$, the function N will be positive; for it is equal to

$$A^{(3)}s+A^{(5)}s^2+A^{(7)}s^3+\ \&c.;$$

and the same function will continue positive, while α increases from zero to the least root of the equation $N=o$. At this limit, N is first equal to zero, and then becomes negative; it must, therefore, be decreasing, and consequently $\frac{dN}{da}$ is negative. It may indeed happen, that, for particular values of s, the coefficients of N may be such, that N and $\frac{dN}{da}$ shall be both equal to zero at the same time; but, in such cases, it will readily appear, that $\frac{dN}{ds}$ and δM will likewise be equal to zero. Wherefore δM will be negative; at least, if it become equal to zero for any particular values of s and α, it cannot become positive. It follows, therefore, that the function M itself will be invariably negative, while s and α increase together from zero to be infinitely great.

Now assume a series of values of s increasing from zero without limit, viz.

$$o,\ s^{(1)},\ s^{(2)},\ s^{(3)},\ \ldots\ldots\ s^{(x)},\ s^{(x+1)}\ \ldots.$$

and having substituted these in the function N, find, by means of the equation $N=o$, the corresponding values of α, viz.

Equations.

$$o,\ \alpha^{(1)},\ \alpha^{(2)},\ \alpha^{(3)},\ \ldots\ldots\ \alpha^{(x)},\ \alpha^{(x+1)}\ \ldots\ldots$$

then, by substituting these values in M, we shall obtain a series of results all negative, and increasing from zero without limit, viz.

$$o,\ -M^{(1)},\ -M^{(2)},\ -M^{(3)}\ \ldots\ -M^{(x)},\ -M^{(x+1)}\ \ldots$$

and whatever be the magnitude of the positive quantity y, it must be contained between two consecutive terms of this last series, viz. between $M^{(x)}$ and $M^{(x+1)}$. But as the values of s may be assumed as near one another as we please, it follows that $M^{(x)}$ and $M^{(x+1)}$ may be made to approach to one another and to y, within any required degree of accuracy. Thus, two values of s and a may be found that will satisfy both the equations,

$$y+M=o$$
$$N=o:$$

and having found these values, we shall obtain the quadratic divisor of the proposed polynome $y+\varphi(u)$, viz. $(u-\alpha)^2+\tau^2$, or

$$(u-\alpha)^2+\lambda^2\alpha^2-s.$$

In the preceding demonstration, it is supposed, that M increases without limit, as s becomes indefinitely great; which may be thus proved: The values of M and N will coincide nearly with the terms containing the highest powers of s and α, when these quantities are very great; and ultimately the functions may be considered as equal to those terms alone. In such circumstances, therefore, the values of the functions will be found by writing α^{2n} for $\varphi(\alpha)$; whence we get

$$M=\alpha^{2n}-2n.\frac{2n-1}{2}.\alpha^{2n-2}(\lambda^2\alpha^2-s)+\ \&c.$$

$$N=2n\alpha^{2n-1}-2n.\frac{2n-1\,.\,2n-2}{2\,.\,3}(\lambda^2\alpha^2-s)+\ \&c.;$$

and if we put $\lambda^2\alpha^2-s=t^2\alpha^2$, or $\alpha^2=\frac{s}{\lambda^2-t^2}$; then,

$$M=\alpha^{2n}\times\left\{1-2n.\frac{2n-1}{2}.t^2+\ \&c.\right.$$

$$N=\alpha^{2n-1}\times\left\{2n-2n.\frac{2n-1\,.\,2n-2}{2\,.\,3}.t^2+\ \&c.\right.$$

Now, s remaining invariable, α will increase as t^2 increases; and the least value of α that will satisfy the equation $N=o$, corresponds to the least value of t^2 that will make the polynome in the expression of N equal to zero; which value, according to what was before shown, is

$$t^2=\tan.^2\frac{1}{n}\times 90^{\circ}.$$

But, if we put $t=\tan.\varphi$, we shall get

$$M=\alpha^{2n}\times\frac{\cos.\,2n\varphi}{\cos.^{2n}\varphi};$$

or, because $\varphi=\frac{1}{n}\times 90^{\circ}$; $\cos.\varphi=\frac{1}{\sqrt{1+t^2}}$, and $\alpha^2=\frac{s}{\lambda^2-t^2}$;

$$M=-s^n\times\left(\frac{1+t^2}{\lambda^2-t^2}\right)^n;$$

which proves the point assumed in the demonstration.

By a similar mode of reasoning, we may likewise prove the former case of the proposition, when y is negative. In this case, the quadratic divisor is $(u-\alpha)^2-\tau^2$; and if we proceed as before, or, which is the same thing, if we change the signs of y and τ^2 in the equations (C) already obtained, and put

$$M=\varphi(\alpha)+\frac{1}{2}.\frac{d^2\varphi(\alpha)}{da^2}.\tau^2+\ \&c.$$

$$N=\frac{d\varphi(\alpha)}{da}+\frac{1}{6}.\frac{d^3\varphi(\alpha)}{da^3}\tau^2+\ \&c.;$$

we shall get

$$-y+M=o$$
$$N=o.$$

Now, by pursuing the steps of the foregoing analysis, we may prove, first, that, for every assumed value of τ^2, a negative value of α may be found, which will satisfy the equation $N=o$; and, secondly, that, when the values which satisfy the equation $N=o$ are substituted in the function M, the results will be invariably positive: whence it follows that a positive value of τ^2, and a negative value of α, may be found that will satisfy both the equations, whatever be the magnitude of y. The analogy between the two cases is thús placed in a strong light; and a little reflection will even bring us to this conclusion, that in reality the one case is a necessary consequence of the other. For since α and τ^2 depend only upon y, and the given coefficients of the polynome, they will be functions of y; wherefore, in the equations of the first case, viz.

$$-y+M=o$$
$$N=o,$$

α being negative, and τ^2 positive, we may suppose $-\alpha=y\varphi(y)$ and $\tau^2=y\Psi(y)$, these values being such as to render each of the equations identical: and then the quadratic divisor $(u-a)^2-\tau^2$ will become

$$\left\{u+y\varphi(y)\right\}^2-y\Psi(y).$$

But, because the foregoing equations become identical by the substitution of the values mentioned, it is a necessary consequence that the equations of the second case, viz.

$$y+M=o$$
$$N=o,$$

in which the signs of y, α, and τ^2, are contrary to what they were in the former equations, will likewise be identical, when $-\alpha=-y\varphi(-y)$ and $\tau^2=-y\Psi(-y)$; and the quadratic divisor, $(u-\alpha)^2-\tau^2$, will now become

$$\left\{u-y\varphi(-y)\right\}^2+y\Psi(-y).$$

Thus when the quadratic divisor of the first case is expressed in terms of y, we have only to change the sign of that quantity, in order to have the quadratic divisor of the second case. It is not difficult to perceive, that what has now been proved is nothing more than another application of the principle employed in Sect. 10; a principle which is the real foundation

of the imaginary arithmetic, with the processes of which the preceding investigations are intimately connected. None but real quantities have occurred in the analysis we have pursued, because we have sought to investigate τ^2 which is always rational; whereas, if we had proposed to find τ, we should inevitably have been led to the real quantity $\sqrt{y}$ in the one case, and to the impossible quantity $\sqrt{-y}$, in the other. These few observations are made for the purpose of throwing light upon a part of analysis, which is certainly obscure in its principles, although there is no question that it is a useful and even a necessary branch of the art of calculation. A fuller elucidation of the subject would be unsuitable to this place; but enough has been said to show that we must seek in the principles of analysis itself for the explanation of the operations it employs; and we may, with great probability, conclude, that no satisfactory account of the imaginary calculus will ever be obtained by having recourse to fanciful geometrical constructions, or to the analogy between the circle and the hyperbola, or to the metaphysical proposition, that all processes with general symbols, whether significant or not, are equally entitled to be considered as demonstrative.

13. Having now proved, in a rigorous manner, that every polynome of even dimensions has at least one quadratic divisor of the one kind or the other, it follows, that it may be reduced by division to another polynome two degrees lower: in like manner, this last polynome will admit of being lowered two degrees more; and by repeating the same process, the first polynome will at length be completely exhausted by quadratic divisors. If, therefore, we recollect, that every polynome of odd dimensions has one binomial divisor, we shall arrive at this general conclusion, "That every rational polynome can be completely exhausted by binomial and trinomial divisors; and, consequently, that it is equal to the product of a certain number of factors of the two first degrees."

It appears also that the binomial factors of any polynome are such only as arise from the resolution of the quadratic divisors; and they are, therefore, either real or imaginary. And thus we finally obtain the following proposition, which was assumed by Harriot, and is the foundation of the received theory of equations, namely, "Every rational polynome has as many binomial factors, and as many roots, real and imaginary, as it has dimensions."

The necessity of confirming, by a general demonstration, the assumed theory of the impossible roots of equations, was early felt; and, accordingly, this point has engaged the attention of all the great mathematicians to whom analysis is indebted for the progress it has made in the course of the last and the present centuries. An account of their several researches would greatly exceed the limits of this article; but the reader will find all the information he can wish for in two long notes (9 and 10) of the *Traité des Equations Numeriques*, by La Grange, in which the author, with his usual elegance, has explained and commented upon the various modes of investigation that have been proposed. It will be sufficient to observe here, that all the demonstations that have appeared are either calculations with impossible quantities, or they proceed upon the assumption, that every equation has as many roots as dimensions, and thus involve the very thing to be proved.

14. The general cases in which mathematicians have been successful in resolving rational functions into their trinomial factors, are confined to the theorem of Cotes, and to a more general proposition of a similar kind, for which we are indebted to De Moivre. These instances are of great importance in analysis, and we shall therefore subjoin an investigation of them, because they are deduced in a very direct manner from the method we have followed.

Suppose, as before, that $f(x)$, or $x^n+A^{(1)}x^{n-1}+A^{(2)}x^{n-2}\ldots+A^{(n-1)}x+A^{(n)}$, is a rational polynome of n dimensions, and $(x-\alpha)^2+\tau^2$ one of its quadratic divisors; put $z=x-\alpha$, substitute $\alpha+z$ for x, and write the transformed function in two lines, one containing all the even, and the other all the odd powers of z; then the polynome will be equal to

$$f(\alpha)+\frac{1}{2}\cdot\frac{d^2f(\alpha)}{d\alpha^2}z^2+\frac{1}{24}\cdot\frac{d^4f(\alpha)}{d\alpha^4}z^4-\&c.$$

$$+z\times\left\{\frac{df(\alpha)}{d\alpha}+\frac{1}{6}\cdot\frac{d^3f(\alpha)}{d\alpha^3}z^2+\frac{1}{120}\cdot\frac{d^5f(\alpha)}{d\alpha^5}z^4\ \&c.\right\}$$

By the same substitution of z for $x-\alpha$, the divisor $(x-\alpha)^2+\tau^2$ will become $z^2+\tau^2$; and, as before, the conditions that $z^2+\tau^2$ shall divide each of the foregoing lines, will be expressed by the following equations, viz.

$$o=f(\alpha)-\frac{1}{2}\cdot\frac{d^2f(\alpha)}{d\alpha^2}\tau^2+\frac{1}{24}\cdot\frac{d^4f(\alpha)}{d\alpha^4}\tau^4-\&c. \qquad \text{(D)}$$

$$o=\frac{df(\alpha)}{d\alpha}-\frac{1}{6}\cdot\frac{d^3f(\alpha)}{d\alpha^3}\tau^2+\frac{1}{120}\cdot\frac{d^5f(\alpha)}{d\alpha^5}\tau^4-\&c.$$

In these formulæ substitute the expanded values of $f(\alpha)$, $\frac{df(\alpha)}{d\alpha}$, &c.; and class together all the homogeneous terms of the same order, that is, all the terms in which the exponents of α and τ amount to the same sum, then we shall have

$$o=\alpha^n-n.\frac{n-1}{2}\alpha^{n-2}\tau^2+\&c.$$

$$+A^{(1)}.\left\{\alpha^{n-1}-\overline{n-1}.\frac{n-2}{2}.\alpha^{n-3}\tau^2+\&c.\right.$$

$$+A^{(2)}.\left\{\alpha^{n-2}-\overline{n-2}.\frac{n-3}{2}\alpha^{n-4}\tau^2+\&c.\right.$$

&c.

$$o=n\alpha^{n-1}-n.\frac{n-1.n-2}{2\ .\ 3}\alpha^{n-3}\tau^2+\&c.$$

$$+A^{(1)}.\left\{(n-1)\alpha^{n-2}-\overline{n-1}.\frac{n-2.n-3}{2\ .\ 3}\alpha^{n-4}\tau^2+\&c.\right.$$

$$+A^{(2)}.\left\{(n-2)\alpha^{n-3}-\overline{n-2}.\frac{n-3.n-4}{2\ .\ 3}\alpha^{n-5}\tau^2+\&c.\right.$$

&c.

Equations.

Now, put $\alpha=r\cos\varphi$, $\tau=r\sin\varphi$; and, by what was proved in Sect. 10, the two foregoing equations will become

$$r^n\cos n\varphi+A^{(1)}r^{n-1}\cos(n-1)\varphi\ldots\ldots+A^{(n-1)}r\cos\varphi$$

$$+A^{(n)}=o \tag{E}$$

$$\frac{1}{\sin\varphi}\cdot\left\{r^{n-1}\sin n\varphi+A^{(1)}r^{n-2}\sin(n-1)\varphi\ldots\ldots+\right.$$

$$\left.A^{(n-1)}\sin\varphi\right\}=o:$$

And the quadratic divisor $(x-\alpha)^2+\tau^2$ will be changed into

$$x^2-2r\cos\varphi.x+r^2.$$

When $\sin\varphi=o$, and $\varphi=o$ or 180°, the preceding equations coincide with these, viz.

$$r^n\pm A^{(1)}r^{n-1}+A^{(2)}r^{n-2}\pm\&c.=o$$

$$nr^{n-1}\pm^{(n-1)}A^{(1)}r^{n-2}+(n-2)A^{(2}r^{n-2}\pm\&c.=o,$$

which express the condition that the given polynome has two or more factors equal to $x\mp r$; at which limits a quadratic divisor changes from being of the form $(x-a)^2-\tau^2$ to be of the form $(x-a)^2+\tau^2$, or the contrary. Thus we learn that, in the equations (E), $\sin\varphi$ must always have a finite value, and then the denominator of the second equation may be neglected.

Let the preceding investigation be applied to find the quadratic factors of x^n-a^n. In this case the two equations (E) will become

$$r^n\cos n\varphi-a^n=o$$

$$r^{n-1}\times\frac{\sin n\varphi}{\sin\varphi}=o:$$

Whence

$$r=a$$
$$\cos n\varphi=1$$
$$\frac{\sin n\varphi}{\sin\varphi}=o.$$

Now, excluding the cases when $\varphi=o$ and $\varphi=180^\circ$, the last equation will be satisfied when $\varphi=\frac{2k+1}{n}\times 180^\circ$, or $\varphi=\frac{2k}{n}\times 180^\circ$, the numerators of the fractions representing all the odd and even numbers less than the common denominator; but the second equation will be satisfied only when $\varphi=\frac{2k}{n}\times 180$: wherefore all the quadratic factors of the function x^n-a^n will be comprehended in the formula

$$x^2-2ax\times\cos\frac{2k}{n}\times 180^\circ+a^2.$$

When n is even number, the quadratic factors will amount to $\frac{n-2}{2}$; and if to them we add the simple factors $x+a$ and $x-a$, we shall have the complete resolution of the function. When n is odd, the number of quadratic factors is $\frac{n-1}{2}$, to which must be added the binomial factor $x-a$.

Equations.

By proceeding in a similar manner in the case of the function x^n+a^n, we shall have the equations

$$r=a$$
$$\cos n\varphi=-1$$
$$\frac{\sin n\varphi}{\sin\varphi}=o.$$

Excluding the cases when $\varphi=o$ and $\varphi=180^\circ$, the second and third equations will be both satisfied, when $\varphi=\frac{2k+1}{n}\times 180^\circ$, the numerator of the fraction representing any odd number less than n.—Wherefore all the quadratic factors will be comprehended in the formula

$$x^2-2ax\times\cos\frac{2k+1}{n}\times 180^\circ+a^2.$$

When n is even, the number of quadratic factors is $\frac{n}{2}$, and they exhibit the complete resolution of the function. When n is odd, the number of quadratic factors is $\frac{n-1}{2}$, to which the binomial factor $x+a$ must be added.

Let us next take the more general function

$$x^{2n}-2\beta x^n\alpha^n+\alpha^{2n}.$$

And, in the first place, when β is greater than unit, the function is equal to

$$\left\{x^n-a^n(\beta+\sqrt{\beta^2-1})\right\}\times\left\{x^n-\alpha^n(\beta-\sqrt{\beta^2-1})\right\};$$

and the quadratic factors may be found by the cases already considered.

When β is less than unit, let $\beta=\cos\theta$, and the function to be resolved will be

$$x^{2n}-2a^nx^n\cos\theta+a^{2n}.$$

By means of the equations (E) we get

$$r^{2n}\cos 2n\varphi-2a^nr^n\cos\theta\cos n\varphi+a^{2n}=o$$

$$r^{2n-1}\times\frac{\sin 2n\varphi}{\sin\varphi}-2a^nr^{n-1}\times\frac{\sin n\varphi}{\sin\varphi}\times\cos\theta=o:$$

And hence

$$r=a$$

$$\text{Cos }2n\varphi-2\cos\theta\cos n\varphi+1=o$$

$$\frac{\sin 2n\varphi}{\sin\varphi}-2\frac{\sin n\varphi}{\sin\varphi}\times\cos\theta=o.$$

But, $\cos 2n\varphi+1=2\cos^2 n\varphi$; and $\sin 2n\varphi=2\cos n\varphi\times\sin n\varphi$; wherefore the two last equations will become

$$2\cos n\varphi(\cos n\varphi-\cos\theta)=o$$

$$2\frac{\sin n\varphi}{\sin\varphi}(\cos n\varphi-\cos\theta)=o:$$

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and these, supposing $\cos\theta$ different from unit, can be satisfied only by making $\cos n\varphi - \cos\theta = o$, or

$$\cos n\varphi = \cos\theta.$$

Now, $\cos\theta = \cos(m \times 360^0 + \theta)$, m being any integer number whatever, zero included; and hence $\varphi = \frac{m \times 360^0 + \theta}{n}$, which formula comprehends all the values of θ that will satisfy the above equations. Wherefore all the factors sought will be contained in this general expression, viz.

$$x^2 - 2ax\cos\frac{m \times 360^0 + \theta}{n} + a^2;$$

in which, if for m we substitute all the integer numbers less than n, zero included, we shall obtain the n quadratic factors of the proposed function.

15. The quadratic divisors $(x-\alpha)^2 - \tau^2$ and $(x-\alpha)^2 + \tau^2$, have hitherto been considered separately; but they may be both represented by $(x-\alpha)^2 - s$, which will coincide with the one or the other according as s is positive or negative. And, if we now proceed as before, we shall get the following equations which express the conditions necessary, in order that the polynome $f(x)$ of any proposed dimensions, as n, shall be divisible by $(x-\alpha)^2 - s$, viz.

$$o = f(\alpha) + \frac{1}{2}\cdot\frac{d^2 f(\alpha)}{d\alpha^2}s + \frac{1}{24}\cdot\frac{d^4 f(\alpha)}{d\alpha^4}\cdot s^2 + \&c.$$

$$o = \frac{df(\alpha)}{d\alpha} + \frac{1}{6}\cdot\frac{d^3 f(\alpha)}{d\alpha^3}\cdot s + \frac{1}{120}\cdot\frac{d^5 f(\alpha)}{d\alpha^5}s^2 + \&c.$$

By eliminating s we shall obtain an equation, viz.

$$A = o,$$

in which α is the unknown quantity. As the process of elimination is independent of the particular values of the coefficients of $f(x)$, the degree of the resulting equation will be the same when the polynome $f(x)$ has as many real roots as dimensions, and when the case is otherwise. But when $f(x)$ is equal to the product of n real binomial factors, the multiplication of every two of them will form a quadratic factor. The number of such factors will, therefore, be equal to $n \times \frac{n-1}{2}$, which expresses all the combinations made with n things taken two and two. Consequently, there will be just so many different values of α that will satisfy the equation $A = o$, which will, therefore, have its exponent equal to $n \times \frac{n-1}{2}$. It thus appears that the equation $A = o$ rises in its dimensions very rapidly above the given polynome, on which account little advantage is derived from this procedure.

Again, by eliminating α from the same two equations we shall obtain one, viz.

$$S = o,$$

in which s is the unknown quantity. This equation, which has already been alluded to (Sect. 8), rises to the same dimensions with the former equation $A = o$; but it is possessed of some useful properties, derived chiefly from the consideration, that every positive root gives a quadratic factor of the form $(x-\alpha)^2 - \tau^2$ in the polynome $f(x)$, and every negative root, a quadratic factor of the form $(x-\alpha)^2 + \tau^2$ in the same polynome.

The quadruple of s is equal to the square of the difference of the two binomial factors of $(x-\alpha)^2 - s$: whence it follows that the quadruples of the several roots of the equation $S = o$ are equal to the squares of the differences of the roots of $f(x) = o$. If, therefore, we put x', x'', x''', &c. for the roots of $f(x) = o$, the roots of $S = o$ will be

$$\frac{1}{4}(x' - x'')^2,\ \frac{1}{4}(x' - x''')^2,\ \frac{1}{4}(x'' - x''')^2,\ \&c.;$$

and from this it is manifest, that the coefficients of the same equation will be known symmetrical functions of the quantities x', x'', x''', &c. or of the roots of $f(x) = o$. The rules formerly explained may, therefore, be employed for calculating the coefficients of $S = o$; and this method of forming the equation is not only more convenient than the process of eliminating; but it likewise has the advantage of enabling us to find any one coefficient separately without computing the rest. Thus, if we put

$$K^{(n)} = (x' - x'')^2 \cdot (x' - x''')^2 \cdot (x'' - x''')^2 \cdot \&c.,$$

and expand this product, and in place of the symmetrical functions of which it is composed, substitute their values in terms of the given coefficients of $f(x) = o$, we shall obtain the value of $K^{(n)}$; and the last term of the equation $S = o$ will be equal to

$$\pm\frac{K^{(n)}}{2^{n(n-1)}},$$

the upper sign taking place when $n \times \frac{n-1}{2}$, the dimensions of the equation $S = o$, is even, and the lower sign when the same number is odd.

If we suppose the given equation $f(x) = o$ to be possessed of as many real roots as dimensions, or to have n real binomial factors, the product of every two of these will be a quadratic factor $(x-\alpha)^2 - s$, in which s is positive; wherefore, the roots of $S = o$ will be all real and all positive. On the other hand, when the given equation $f(x) = o$ has not as many real roots as dimensions, it will be divisible by one or more quadratic factors not resolvable into real binomial factors, and in which s is negative; consequently, the equation $S = o$ will have one or more negative roots. It is, therefore, a property of the auxiliary equation $S = o$, that when the roots are all real, they are all positive; and when they are not all real, some of them are negative. Now the rule of Descartes will enable us to find whether the roots are all positive or not; and by this means we shall discover whether the roots of the given equation $f(x) = o$ are all real or not. From what has been said we may lay down this rule: "The proposed equation $f(x) = o$ will have all its roots real, when the auxiliary equation $S = o$ has as many variations from one sign to another as it has dimensions, or when its terms are alternately positive and negative; otherwise the proposed equation will have one or more quadratic factors of the form $(x-\alpha)^2 + \tau^2$, but

the number of such factors cannot exceed the continuations of the same sign in the auxiliary equation."

Again, in the equation S$=o$, the polynome S is equal to a certain number of binomial factors of the forms $x-a$ and $x+a$, multiplied into a supplementary polynome of even dimensions, which, not being capable of having a negative value, will have its last term positive (Sect. 5). It is manifest, therefore, that the last term of S$=o$ will be positive or negative, according as the number of factors of the form $x-a$ is even or odd, that is, according as the equation has an even or odd number of real and positive roots. But every two real roots in the equation $f(x)=o$ give one real and positive root in the subsidiary equation S$=o$: wherefore, if m denote the number of real roots in the former equation, the number of real and positive roots in the latter will be equal to $m\times\frac{m-1}{2}$; and the last term of the subsidiary equation will be positive or negative, according as $m\times\frac{m-1}{2}$ is an even or an odd number.

In a cubic equation $x^3+px+q=o$, m is either one or three. In the first case, the equation S$=o$ will have no positive roots, and the last term will be positive; in the second case, it will have three real and positive roots, and the last term will be negative. Now, the dimensions of S$=o$ being odd, the function $K^{(3)}$ will be negative in the first case, and positive in the second. Wherefore the given cubic equation will have one real root, or three, according as the function $K^{(3)}$, that is,

$$(x'-x'')^2.(x'-x''')^2.(x''-x''')^2,$$

or $-4p^3-27q^2$, is negative or positive.

In a biquadratic equation $x^4+px^2+qx+r=o$, m is equal to zero, or two, or four. In the first case, the equation S$=o$ has no positive roots, in the third, it has six; and in both cases the last term is positive. In the second case, the same equation has only one real and positive root, and the last term is negative. The dimensions of S$=o$, equal to $\frac{4\times 3}{2}$, being even, the function $K^{(4)}$ will be positive in the first and third cases, and negative in the second case. Wherefore the proposed biquadratic equation will have only two real roots when the function $K^{(4)}$, that is, $(x'-x'')^2.(x'-x''')^2.(x'-x^{\text{iv}})^2.(x''-x''')^2.(x''-x^{\text{iv}})^2$ $(x'''-x^{\text{iv}})^2$, or, $256r^3-128p^2r^2+144q^2pr+16p^4r-27q^4-4q^2p^3$, is negative; and when the same function is positive, the proposed equation will have four real roots, if the terms of the auxiliary equation S$=o$ be alternately positive and negative; otherwise it will have no real roots.

In an equation of the fifth degree, m is equal to one, or three, or five. In the first and third cases, the last term of S$=o$ will be positive, for there are either no positive roots or ten; in the second case the last term is negative, the number of positive roots being three. The dimensions of S$=o$, equal to $\frac{5\times 4}{2}$, being even, the function $K^{(5)}$ will be positive in the first and third cases, and negative in the second. Wherefore the given equation of the fifth degree will have three real roots when the function $K^{(5)}$ is negative; and when the same function is positive, it will have five real roots, if the terms of the auxiliary equation S$=o$ be alternately positive and negative; otherwise it will have but one.

Resolution of Algebraic Equations.

16. When the coefficients of an equation are given in numbers, we may investigate the numerical value of any one root separately, by first seeking the limits between which it lies, and then narrowing those limits to any required degree of approximation. But this process is not what is meant by the general solution of algebraical equations, which supposes that the coefficients are denoted by general symbols, and consists in finding such a function of those quantities as shall, by the multiplicity of its values, represent all the roots. An algebraic expression is susceptible of many values, by means of the different radical quantities it contains; but, these radical quantities being themselves the roots of an equation, it follows that the general formula for the solution of any proposed equation can be nothing more than a function of the given coefficients combined with the roots of another equation.

The solution of quadratic equations has been known since the origin of algebra; it is found in the work of Diophantus, the first treatise on the science extant, if it be not the very first that was written. The Italian mathematicians, who are the founders of the modern algebra, discovered the solution of cubic and biquadratic equations. The rules they invented for this purpose are, however, rather the result of particular artifices, than deductions from any profound views of the structure of the equations they considered. In the course of the last and the present centuries, the general solution of equations has been the subject of almost innumerable researches by all the mathematicians of the first rank; but their labours have not been successful in advancing this branch of the science beyond the steps made by the first algebraists.

The rules usually given for the solution of cubic and biquadratic equations are to be found in all the elementary books, and it would be superfluous to repeat them here. An account of the attempts that have been made to obtain a general theory for solving algebraic equations would greatly exceed the limits we must prescribe to ourselves. What has most impeded the progress of algebraists in their researches on this subject, is the difficulty of treating it by a perfect analysis, or of arriving at general conclusions by a process of reasoning founded solely on the principles of the inquiry, and disengaged from particular artifices of calculation, and from particular suppositions. In what follows, we shall endeavour to lay before our readers the general principles on which is founded all that has been successfully accomplished in this theory.

Solution of Cubic Equations.

Let the three roots of a cubic equation be represented by a, b, c; and having interchanged these letters among one another, in all possible ways, we shall get the six permutations following, viz.

$$\begin{array}{lll} abc, & cab, & bca \\ acb, & bac, & cba. \end{array}$$

The combinations that stand first on the left are formed by prefixing the same letter to the permutations made with the other two; and those on each line are derived from one another by making the last letter of one stand first in that which follows, while the other two letters preserve the same order.

Now let $\varrho^3-1=o$; and let the letters of first combination of each line be prefixed in order to the three terms of $1+\varrho+\varrho^2$; then we shall get

$$t=a+b\varrho+c\varrho^2 \quad , \quad s=a+c\varrho+b\varrho^2;$$

and if we multiply t and s by 1, ϱ, ϱ^2 successively, we shall further obtain

$$\begin{array}{ll} t=a+b\varrho+c\varrho^2 \quad , & s=a+c\varrho+b\varrho^2 \\ t\varrho=c+a\varrho+b\varrho^2 & s\varrho=b+a\varrho+c\varrho^2 \\ t\varrho^2=b+c\varrho+a\varrho^2 & s\varrho^2=c+b\varrho+a\varrho^2. \end{array}$$

The six quantities t, $t\varrho$, $t\varrho^2$, s, $s\varrho$, $s\varrho^2$ comprehend all the values that can be formed by combining with $1+\varrho+\varrho^2$, the three letters taken in any order whatever; and it is obvious that the cubes of all these six quantities, being each equal either to t^3 or s^3, have no more than two values.

And because t^3 and s^3 have only one value each, any symmetrical functions of them, as t^3+s^3 and t^3s^3, will have determinate values, which remain the same, however the letters a, b, c be interchanged among one another. The quantities t^3+s^3 and t^3s^3 must, therefore, be symmetrical functions of a, b, c; and, consequently, they can be found in terms of the coefficients of the given equation.

By actually involving to the third power, we get

$$\begin{aligned} t^3=\;&a^3+b^3+c^3+6abc \\ &+3(a^2b+b^2c+c^2a)\cdot\varrho \\ &+3(a^2c+c^2b+b^2a)\cdot\varrho^2 \\ s^3=\;&a^3+b^3+c^3+6abc \\ &+3(a^2c+c^2b+b^2a)\cdot\varrho \\ &+3(a^2b+b^2c+c^2a)\cdot\varrho^2. \end{aligned}$$

and likewise

$$\begin{aligned} (a+b+c)^3=\;&a^3+b^3+c^3+6abc \\ &+3(a^2b+b^2c+c^2a) \\ &+3(a^2c+c^2b+b^2a). \end{aligned}$$

Now $1+\varrho+\varrho^2=o$, when ϱ is any root of $\varrho^3-1=o$ different from unit; therefore, by adding the three last expressions, we get

$$\begin{aligned} t^3+s^3=\;&3(a^3+b^3+c^3)+18abc \\ &-(a+b+c)^3. \end{aligned}$$

Again, by actually multiplying

$$\begin{aligned} ts=\;&a^2+b^2+c^2 \\ &+(ab+bc+ca)\cdot\varrho \\ &+(ab+bc+ca)\cdot\varrho^2; \end{aligned}$$

and, because $\varrho+\varrho^2=-1$,

$$\begin{aligned} ts=\;&a^2+b^2+c^2 \\ &-(ab+bc+ca). \end{aligned}$$

By means of the preceding formulæ, we can compute the values of t^3+s^3 and t^3s^3; and these values being the coefficients of a quadratic equation having its roots equal to t^3 and s^3, we can thence find t^3 and s^3, and t and s. Now t and s being known, we have

$$\begin{aligned} a+b+c&=a+b+c \\ t&=a+b\varrho+c\varrho^2 \\ s&=a+c\varrho+b\varrho^2; \end{aligned}$$

wherefore,

$$a=\frac{1}{3}(a+b+c)+\frac{1}{3}(t+s)$$

$$b=\frac{1}{3}(a+b+c)+\frac{1}{3}(t\varrho^2+s\varrho)$$

$$c=\frac{1}{3}(a+b+c)+\frac{1}{3}(t\varrho+s\varrho^2).$$

To apply the foregoing investigation, we shall take a cubic equation, $x^3-3px-2q=o$, which is so prepared as to want the second term, then (Sect. 9)

$$\begin{aligned} a+b+c&=o \\ ab+ac+bc&=-3p \\ a^2+b^2+c^2&=6p \\ a^3+b^3+c^3&=6q \\ abc&=2q. \end{aligned}$$

consequently $t^3+s^3=3\times 2q$; $ts=9p$, and $t^3s^3=3^3\times 3^3\,.\,p^3$. Hence

$$\frac{1}{3}t=(q+\sqrt{q^2-p^3})^{\frac{1}{3}}$$

$$\frac{1}{3}s=(q-\sqrt{q^2-p^3})^{\frac{1}{3}}.$$

Wherefore, by substituting these values in the expressions of the roots, we get

$$\begin{aligned} a&=(q+\sqrt{q^2-p^3})^{\frac{1}{3}}+(q-\sqrt{q^2-p^3})^{\frac{1}{3}} \\ b&=\varrho^2\cdot(q+\sqrt{q^2-p^3})^{\frac{1}{3}}+\varrho\cdot(q-\sqrt{q^2-p^3})^{\frac{1}{3}} \\ c&=\varrho\cdot(q+\sqrt{q^2-p^3})^{\frac{1}{3}}+\varrho^2\cdot(q-\sqrt{q^2-p^3})^{\frac{1}{3}}. \end{aligned}$$

The preceding investigation, as well as all other methods that have been proposed for cubic equations, leads to the same result with the rule invented by Cardan; and, like that rule, it becomes, in some cases, insufficient for arithmetical computation, on account of the imaginary quantities that appear in the expressions of the roots. What is now mentioned is not an accidental circumstance, but a necessary consequence of the method of investigation pursued, and of the introduction of the imaginary roots of the equation $\varrho^3-1=o$. When a, b, c, are real quantities, the values of t and s will be both imaginary, because they involve ϱ and ϱ^2, or $\dfrac{-1+\sqrt{-3}}{2}$ and $\dfrac{-1-\sqrt{-3}}{2}$. In this case, therefore, although the three roots of the proposed equation are all real, yet the algebraic expressions of them are all imaginary,

and useless for the purpose of numerical calculation; and the former circumstance is precisely the reason of the latter. On the other hand, when one root a is real and the other two imaginary, the impossible quantities destroy one another in the expressions of t and s, which are, therefore, real quantities; and in this case, the algebraic formulæ answer for finding the numerical values of the roots. The distinction here pointed out depends on the radical $\sqrt{q^2-p^3}$, which is real or imaginary, according as the equation has one or three real roots, because q^2-p^3 is always positive in the first case, and negative in the second.

Much labour and thought have been bestowed in order to free the formulæ for the roots of cubic equations, from the imaginary expressions that render them unfit for arithmetical computation. In particular instances the difficulty disappears; namely, when the radical quantities are perfect cubes, in which cases the impossible parts of the cube roots destroy one another, so as to leave none but real quantities in the expressions of the roots of the equation. And by expanding the radical quantities we may, in all cases, obtain the roots of a cubic equation in series of an infinite number of terms free from the imaginary sign. But when it is required to transform the formulæ for the case of a cubic equation with three real roots, into finite expressions free from impossible quantities, and to do so without employing any other than the received notations of algebra, all attempts to solve the problem have led to equations in the same circumstances with the one proposed, and have ended in bringing back the same difficulty; in so much that equations of the description mentioned are said to be in the irreducible case.

It is, however, possible to transform the formulæ for the roots of a cubic equation in the irreducible case into real expressions, although not so as to fulfil all the conditions above mentioned. Let $q^2-p^3=y^2$; then $p=(q^2-y^2)^{\frac{1}{3}}$: wherefore the equation $x^3-3px-2q=o$, will become

$$x^3-3(q^2-y^2)^{\frac{1}{3}}x-2q=o \quad . \; . \; . \; (1).$$

By the preceding formula, the value of x in this equation will be

$$x=(q+y)^{\frac{1}{3}}+(q-y)^{\frac{1}{3}};$$

or, according to the notation of Sect. 10, making $n=\frac{1}{3}$,

$$x=2\mathrm{H}_{\frac{1}{3}}(q,\, y^2).$$

By substituting this value of x we get

$$\left\{2\mathrm{H}_{\frac{1}{3}}(q,\, y^2)\right\}^3-3(q^2-y^2)^{\frac{1}{3}}.\left\{2\mathrm{H}_{\frac{1}{3}}(q,\, y^2)\right\}-2q=o:$$

which equation being true for all values of q and y^2, must be identical, or, when expanded, must consist of a series of quantities that mutually destroy one another. Now the equation will still be identical, when y^2 is changed into $-y^2$: so that we shall have

$$\left\{2\mathrm{H}_{\frac{1}{3}}(q,-y^2)\right\}^3-3(q^2+y^2)^{\frac{1}{3}}\left\{2\mathrm{H}_{\frac{1}{3}}(q,-y^2)\right\}-2q=o;$$

and this proves that the equation

$$x^3-3(q^2+y^2)^{\frac{1}{3}}.\, x-2q=o \quad . \; . \; . \; (2)$$

is solved by the formula

$$x=2\mathrm{H}_{\frac{1}{3}}(q,-y^2).$$

As the investigation in Sect. 10 is equally true, whether n be a whole or a fractional number, we may apply it to find the value of the symbol $2\mathrm{H}_{\frac{1}{3}}(q,-y^2)$.

For this purpose, let

$$q=r\cos\varphi=r\cos(\varphi+360^\circ)=r\cos(\varphi+2.360^\circ),$$
$$y=r\sin\varphi=r\sin(\varphi+360^\circ)=r\sin(\varphi+2.360^\circ);$$

then $r=\sqrt{q^2+y^2}$; and, according as we take one or other of the angles that have the same sines and cosines, we shall obtain three different values of $2\mathrm{H}_{\frac{1}{3}}(q,-y^2)$, or of x, viz.

$$a=2r^{\frac{1}{3}}.\cos\frac{\varphi}{3}$$
$$b=2r^{\frac{1}{3}}.\cos\left(\frac{\varphi}{3}+120^\circ\right)$$
$$c=2r^{\frac{1}{3}}.\cos\left(\frac{\varphi}{3}+240^\circ\right).$$

By putting $p=(q^2+y^2)^{\frac{1}{3}}$, the equation (2) will assume the same form as at first, namely,

$$x^3-3px-2q=o;$$

and because $p^3=q^2+y^2=r^2$, and $y=\sqrt{p^3-q^2}$; if we determine the angles by means of their tangents, instead of their sines and cosines, we shall get

$$\frac{\sqrt{p^3-q^2}}{q}=\tan\varphi=\tan(\varphi+360^\circ)=\tan(\varphi+2\,.\,360^\circ);$$

and the three roots of the equation will be

$$a=2\sqrt{p}\,.\cos.\frac{\varphi}{3}$$
$$b=2\sqrt{p}\,.\cos\left(\frac{\varphi}{3}+120^\circ\right)$$
$$c=2\sqrt{p}\,.\cos\left(\frac{\varphi}{3}+240^\circ\right).$$

Every cubic equation falls under one or other of the formulæ (1) and (2), except when $y=o$, or $p^3=q^2$, which takes place when an equation changes from one class to another; and in this case we have

$$x^3-3q^{\frac{2}{3}}.\,x-2q=(x-2q^{\frac{1}{3}}).(x+q^{\frac{1}{3}}).(x+q^{\frac{1}{3}}).$$

The several rules that have now been given, therefore, include every possible case.

The difficulty attending the irreducible case arises from a real distinction between the two subordinate classes of cubic equations, and is insurmountable by the ordinary operations of algebra. There is no permanent distinctions of equations belonging to the same order, when we consider their roots as positive

or negative; because, in any proposed equation, all the roots, or as many of them as we please, can be changed from positive to negative, by the simple artifice of increasing or diminishing them all by a given quantity. But the case is otherwise when we consider the roots of an equation in their character of real or imaginary quantities. No transformation can change an equation with one real root into another with three real roots, without involving the operations of the impossible arithmetic. If, therefore, we lay down this condition, namely, that the formulæ for the roots of equations must be in a shape fit for numerical calculation; we may conclude that, in fact, there is no resolution of equations except what consists in reducing all those of the same class to some one of that class, the most simple and convenient in its form, that can be found. If we examine the preceding investigation, it will appear that it is merely an attempt to reduce all cubic equations to the form $x^3-A=o$; and this readily succeeds, without impossible operations, when the proposed equation and that with which it is compared have their roots of a similar description; and it as surely fails when the case is otherwise.

In geometry, where the relations of the magnitudes under consideration are never lost sight of, there is no tendency to refer the solution of a problem to a class to which it does not belong. The ancient geometer could never be in danger of applying the problem for finding two mean proportionals to a case that can be constructed only by the trisection of an angle. The modern analyst, dismissing the original magnitudes of his problem, and reducing all possible relations to equations in abstract numbers, is apt to overlook distinctions, and sometimes to waste his labour, in seeking to accomplish what a due separation of cases would show to be impossible. There is the same distinction between the class of cubic equations with one real root, and that with three real roots, that there is between the two geometrical problems alluded to above; and the algebraist who attempts, by means of the ordinary operations of his art, to transform Cardan's formula so as to make it apply to the irreducible case, is precisely in the same situation with the geometer who should set about trisecting an angle by finding two mean proportionals.

The power and force of the algebraic method does not consist in breaking down real distinctions, but in connecting, by sure and general principles, many truths which, in geometry, are joined only by vague analogies, and even have no affinity at all. This advantage is derived chiefly from the doctrine of negative quantities, and from the impossible arithmetic. By means of the first, a formula which is obtained by considering only one state of the data of a problem, applies, necessarily and by the very structure of analytical language, to the same problem in all possible conditions of the data. On the other hand, when the relations of the data vary, the geometer is obliged to subdivide his problem into cases, or into other subordinate problems; and although it may be perceived that great similitude prevails among all the subdivisions, yet it is impossible to reduce the analogy between them to determinate rules, as is done in algebra. But, in the whole compass of geometry, there is nothing that bears any resemblance to the imaginary arithmetic. When the geometer has fixed the *determination* of his problem, or ascertained the limits within which it is possible, he has drawn a line that must be the boundary of his investigation. Now, it is to truths lying beyond this line that the meaning of the comprehensive expressions of the imaginary arithmetic must be referred. It is not to be understood that a problem can be solved by algebra, which is impossible in geometry; but the analytical formulæ, at the same time that they mark the limits of the problem, go beyond them, and point out connected truths, that require only certain changes to be made in the algebraic expressions; in like manner, as all the possible cases of the same problem are derived from one only, by means of the variations of the signs.

Biquadratic Equations.

If a, b, c, d, represent the four roots of a biquadratic equation; and if we prefix the same letter a to all the permutations made with the other three, we shall get the six combinations following, viz.

abcd, *adbc*, *acdb*,
adcb, *acbd*, *abdc*.

In the first line, the letters b, c, d, are made to circulate, by placing immediately after the immoveable letter a that which stands last in the combination preceding; and, in the second line, the moveable letters have, respectively, an inverted order to what they have in the first line.

Let $\varrho^2-1=o$; and let the four letters taken in the several orders of the six combinations be prefixed to the terms of $1+\varrho+\varrho^2+\varrho^3$; the results of the first line being t, t', t'', and those of the second line s, s', s''; then

$$t=a+b\varrho+c\varrho^2+d\varrho^3 \qquad s=a+d\varrho+c\varrho^2+b\varrho^3$$
$$t'=a+d\varrho+b\varrho^2+c\varrho^3 \qquad s'=a+c\varrho+b\varrho^2+d\varrho^3$$
$$t''=a+c\varrho+d\varrho^2+b\varrho^3, \qquad s''=a+b\varrho+d\varrho^2+c\varrho^3.$$

Now, in the equation $\varrho^2-1=o$, ϱ is either equal to $+1$, or to -1; and whether we take the one value or the other, it is apparent that $t=s$, $t'=s'$, $t''=s''$.

Again, from every one of the six foregoing combinations, four others are derived by circulating the letters continually from the last place to the first; and, in this manner, we obtain twenty-four different permutations, which are all that can be made with four letters. Thus, if we take *abcd*, and move the letters as directed, we shall get these four combinations, viz.

abcd
dabc
cdab
bcda.

And if we multiply t by ϱ continually, observing to retain the three first powers of ϱ, and to make $\varrho^4=1$, we shall get

$$t=a+b\varrho+c\varrho^2+d\varrho^3$$
$$t\varrho=d+a\varrho+b\varrho^2+c\varrho^3$$
$$t\varrho^2=c+d\varrho+a\varrho^2+b\varrho^3$$
$$t\varrho^3=b+c\varrho+d\varrho^2+a\varrho^3;$$

so that t, $t\varrho$, $t\varrho^2$, $t\varrho^3$, are the functions formed by prefixing to $1+\varrho+\varrho^2+\varrho^3$, the letters of the four combinations; and it is obvious that these functions have all the same square, equal to t^2.

Wherefore, if the four letters, taken in all possible orders, be prefixed to the terms of $1+\varrho+\varrho^2+\varrho^3$, the squares of the twenty-four resulting functions will be equal to one or other of the six quantities, t^2, t'^2, t''^2, s^2, s'^2, s''^2; and since it has been proved that $t=s$, $t'=s'$, $t''=s''$; it follows that the twenty-four squares have no more than three different values, equal to t^2, t'^2, t''^2.

And, because t^2, t'^2, t''^2, can have no more than one value each, any symmetrical functions of them, viz.

$$t^2+t'^2+t''^2$$
$$t^2t'^2+t^2t''^2+t'^2t''^2$$
$$t^2t'^2t''^2,$$

will have determinate values independent of the order of the letters a, b, c, d. The same functions will therefore be symmetrical expressions of the roots of the given biquadratic equation, and they will be known in terms of the coefficients of that equation.

Supposing $\varrho=-1$, we get

$$t=a-b+c-d$$
$$t'=a-d+b-c$$
$$t''=a-c+d-b\,;$$

and hence,

$$t^2=a^2+b^2+c^2+d^2$$
$$-2(ab+ad+bc+cd)+2(ac+bd)$$
$$=(a+b+c+d)^2-4\Sigma.ab+4(ac+bd)\,;$$

the symbol $\Sigma.ab$ being used here, as in Sect. 9, to denote the sum of the products of every two of the roots. Wherefore, if we put

$$\mathrm{M}=(a+b+c+d)^2-4\Sigma.ab$$
$$m=ac+bd$$
$$m'=ab+dc$$
$$m''=ad+bc,$$

then

$$t^2=\mathrm{M}+4m$$
$$t'^2=\mathrm{M}+4m'$$
$$t''^2=\mathrm{M}+4m''\,;$$

and hence,

$$t^2+t'^2+t''^2=3\mathrm{M}+4(m+m'+m'')$$
$$t^2t'^2+t^2t''^2+t'^2t''^2=3\mathrm{M}^2+8\mathrm{M}(m+m'+m'')$$
$$+16(mm'+mm''+m'm'').$$

But it will readily appear that

$$m+m'+m''=\Sigma.ab$$
$$mm'+mm''+m'm''=(a+b+c+d)\times\Sigma.abc$$
$$-4abcd.$$

Now, by substituting these values, we get

$$t^2+t'^2+t''^2=3(a+b+c+d+)^2-8\Sigma.ab$$
$$t^2t'^2+t^2t''^2+t'^2t''^2=3(a+b+c+d)^4-16(a+b+c+d)^2\times\Sigma.ab$$
$$+16(a+b+c+d)\times\Sigma.abc+16(\Sigma.ab)^2$$
$$-64abcd.$$

Again, if we multiply the expressions of t, t', t'', we shall get

$$tt't''=(a-c).(a^2-c^2)+(b-d).(b^2-d^2)$$
$$-(a+c)(b-d)^2-(b+d)(a-c)^2\,;$$

or, $tt't''=a^3+b^3+c^3+d^3+2\Sigma.abc$

$$-(a^2b+a^2c+a^2d+b^2a+b^2c+b^2d$$
$$+c^2a+c^2b+c^2d+d^2a+d^2b+d^2c)\,;$$

and finally, by means of the formulæ in Sect. 9,

$$tt't''=(a+b+c+d)^3+8\Sigma.abc$$
$$-4(a+b+c+d)\times\Sigma.ab.$$

If now we substitute the values computed by the preceding formulæ, in the cubic equation,

$$o=u^3-(t^2+t'^2+t''^2)u^2$$
$$+(t^2t'^2+t^2t''^2+t'^2t''^2)u$$
$$-t^2t'^2t''^2,$$

we shall obtain the values of t^2, t'^2, t''^2, and consequently of t, t', t'', by solving that equation: and, when t, t', t'' are known, we have

$$a+b+c+d=a+b+c+d$$
$$t=a+b\varrho+c\varrho^2+d\varrho^3$$
$$t'=a+d\varrho+b\varrho^2+c\varrho^3$$
$$t''=a+c\varrho+d\varrho^2+b\varrho^3\,;$$

wherefore, because $o=1+\varrho+\varrho^2+\varrho^3$, we get

$$a=\frac{1}{4}\left\{a+b+c+d+t+t'+t''\right\}$$
$$b=\frac{1}{4}\left\{a+b+c+d+t\varrho^3+t'\varrho^2+t''\varrho\right\}$$
$$c=\frac{1}{4}\left\{a+b+c+d+t\varrho^2+t'\varrho+t''\varrho^3\right\}$$
$$d=\frac{1}{4}\left\{a+b+c+d+t\varrho+t'\varrho^3+t''\varrho^2\right\}$$

And finally, by making $\varrho=-1$,

$$a=\frac{1}{4}\left\{a+b+c+d+t+t'+t''\right\}$$
$$b=\frac{1}{4}\left\{a+b+c+d-t+t'-t''\right\}$$
$$c=\frac{1}{4}\left\{a+b+c+d+t-t'-t''\right\}$$
$$d=\frac{1}{4}\left\{a+b+c+d-t-t'+t''\right\}.$$

In applying these formulæ, it is necessary to observe, that, as the quantities t, t', t'', are found by extracting the square root, they may each have either the sign plus or the sign minus prefixed. But all ambiguity from this cause will be taken away, if it be observed, that the expressions of a, b, c, d, will always give the same results, provided the signs of t, t', t'', be so determined as to satisfy the equation,

$$tt't''=(a+b+c+d)^3+8\Sigma\,.\,abc$$
$$-4(a+b+c+d)\times\Sigma\,.\,ab.$$

For, if we suppose that the signs of t, t', t'', are so determined as to satisfy the equation mentioned, they cannot be varied so as still to satisfy the same

equation, unless two of them be changed together; for, if one sign only be changed, or if all the three be changed together, the product $tt't''$ will have an opposite sign to what it had before, and the equation will no longer be satisfied. But the expressions of a, b, c, d, give the same set of values when the signs of any two of the letters t, t', t'', are changed together; so that, in order to have the true values of the quantities sought, no other rule for the signs of t, t', t'', is necessary than that they must be such as to satisfy the equations alluded to.

To apply the preceding investigation we may take the equation,

$$x^4+px^2+qx+r=o,$$

which wants the second term. Then,

$$\begin{aligned} o&=a+b+c+d \\ p&=\Sigma\,.\,ab \\ -q&=\Sigma\,.\,abc \\ r&=abcd: \end{aligned}$$

hence

$$\begin{aligned} t^2+t'^2+t''^2&=-8p \\ t^2t'^2+t^2t''^2+t'^2t''^2&=16p^2-64r \\ tt't''&=-8q: \end{aligned}$$

and t^2, t'^2, t''^2, are the roots of the cubic equation,

$$u^3+8pu^2+16(p^2-4r)u-64q^2=o.$$

Having solved this equation, and found the values of t, t', t'', the signs of these quantities must next be determined so as to satisfy the equation,

$$tt't''=-8q;$$

and then we have these formulæ for computing the roots of the proposed equation, viz.

$$a=\frac{t+t'+t''}{4}$$

$$b=\frac{-t+t'-t''}{4}$$

$$c=\frac{t-t'-t''}{4}$$

$$d=\frac{-t-t'+t''}{4}.$$

These formulæ coincide with the method of solving biquadratic equations first proposed by Euler in his Algebra. But, in order to take away the ambiguity arising from the double sign of the square root, that celebrated mathematician uses two sets of expressions for the roots of the equation, viz.

$$a=\frac{t+t'+t''}{4} \qquad a=\frac{-t-t'-t''}{4}$$

$$b=\frac{-t+t'-t''}{4} \qquad b=\frac{t-t'+t''}{4}$$

$$c=\frac{t-t'-t''}{4} \qquad c=\frac{-t+t'+t''}{4}$$

$$d=\frac{-t-t'+t''}{4} \qquad d=\frac{t+t'-t''}{4}$$

of which one set is the same with the formulæ given above, and the other is obtained by changing t, t', t'' into $-t, -t', -t''$; the first set being directed to be used when $-8q$ is positive, and the other set when the same quantity is negative. This procedure is not so simple as that we have followed, which requires only one set of formulæ. It has even been the occasion of leading into error, in as much as it makes the signs of t, t', t'', depend entirely upon the sign of the given quantity $-8q$; whereas, it is indispensable that, regard being had to the nature of the quantities t, t', t'', their signs shall be determined so as to satisfy the equation $tt't''=-8q$. This inadvertence of Euler has escaped the observation of most of the authors who have treated of biquadratic equations, and was first noticed by M. Bret in the second volume of the *Correspondance sur l'Ecole Polytechnique*.

It may not be improper to notice briefly some of the other rules for biquadratic equations. These are chiefly two; the method of Descartes, which resolves the given equation into two quadratic factors; and the oldest method of all, invented by Louis Ferrari, a pupil of Cardan, which proceeds by transforming the given equation, so as to make it equal to the difference of two complete squares, and then extracting the square roots. However different from one another these two methods may at first seem, they are at bottom the same; and they are so far connected with that already investigated, that all the three lead to the same cubic equation.

Suppose that a, b, c, d, are the roots of the biquadratic equation,

$$x^4-Ax^3+Bx^2-Cx+D=o;$$

then $x^2-(a+b)x+ab=o$, and $x^2-(c+d)x+cd=o$, are two quadratic factors, the product of which is equal to the given equation. Now,

$$\begin{aligned} A&=a+b+c+d \\ t&=a+b-c-d; \end{aligned}$$

wherefore, if we put $ab=p+y$, $cd=p-y$, the two factors will become

$$x^2-\frac{1}{2}(A+t)x+p+y=o$$

$$x^2-\frac{1}{2}(A-t)x+p-y=o:$$

and if we multiply them, and equate the coefficients of the product to the coefficients of the given equation, we shall get

$$\begin{aligned} 2p+\frac{1}{4}A^2-\frac{1}{4}t^2&=B \\ Ap+ty&=C \\ p^2-y^2&=D. \end{aligned}$$

And it is to be observed that, on account of the two first of these equations, p and y are both real quantities when t is a real quantity; so that, provided a real value of t can be found, the given equation is always resolved, by this method, into two quadratic factors free from imaginary expressions.

Now, by combining the equations just found, we shall get

$$\begin{aligned} o=t^6&-(3A^2-8B)\,.\,t^4 \\ &+(3A^4-16A^2B+16B^2+16AC-64D)\,.\,t^2 \\ &-(A^3-4AB+8C)^2, \end{aligned}$$

Equations.

$$p=\frac{1}{2}B-\frac{1}{8}A^2+\frac{1}{8}t^2,$$

$$y=\sqrt{\left(\frac{1}{2}B-\frac{1}{8}A^2+\frac{1}{8}t^2\right)^2-D}.$$

The first of these equations is a cubic, of which the root is t^2; and it is precisely the same with the cubic of the former method. As the last term of this equation is essentially positive, it follows, that there is always one positive value of t^2, and one real value of t; wherefore, in consequence of what has been proved, the values of p and y, derived from the positive value of t^2, are in every case real quantities, which is, no doubt, an advantage in the practical application of the method.

If we wish to follow the process of Louis Ferrari, we may assume p, t, y, so as to render the expression

$$\left(x^2-\frac{1}{2}Ax+p\right)^2-\left(\frac{1}{2}tx+y\right)^2=o,$$

identical with the given equation; and as this expression is no more than the product of the two quadratic factors of the last method, the quantities to be determined will be found by the formulæ already given.

Equations of the Fifth Degree.

The theory of permutations, which is successful in solving cubic and biquadratic equations, applies likewise to those of the fifth and higher orders. But, to use the words of Lagrange, "Passé le quatrième degré, la méthode, quoiqu' applicable en général, ne conduit plus qu' à des equations résolvantes de degrés supérieurs à celui de la proposée." Thus, in the case of equations of the fifth degree, the theory leads to a biquadratic equation of which the coefficients are to be found by resolving an equation of the sixth order.

There is, however, no doubt that the doctrine of permutations contains the principles from which we are to expect the resolution of equations of the higher orders, if the problem be possible. It may be alleged, with great probability, that the theory succeeds in the less complicated cases, because, when the number of the roots is small, their permutations are soon exhausted, and we speedily arrive at those combinations of them which remain invariable, whatever be the order of the quantities combined. But when the number of the roots is greater than four, their permutations are very numerous, and, at the same time, the functions produced by combining them are very complicated; on which accounts it is difficult to conduct the investigation so as to arrive at a satisfactory conclusion, either accomplishing the intended purpose, or proving that the undertaking is impossible.

In the twelfth volume of the *Italian Society*, and in a work published at Modena in 1813, M. Paolo Ruffini has proved, that no function of five letters can exist that is susceptible of only three or four different values when the letters are interchanged among one another in all possible ways. M. Cauchy, in the sixteenth volume of the *Journal de l'Ecole Polytechnique*, has demonstrated, that a function of n letters, unless it have no more than two different values, cannot have a number of different values less than the prime number next below n. On these grounds, it has been inferred, that the resolution of equations of the fifth degree is in reality an impossible problem. (Lacroix, *Compt. des Elem. d'Algebre*, p. 61.) And, if it be admitted that, in the process of resolution, no equations can occur except such as have symmetrical functions of the five letters for their coefficients, the inference founded on the labours of the eminent mathematicians we have mentioned would be indisputable. But it is not impossible that the resolution of equations of a high order must be effected by gradually depressing an equation at first of great dimensions; and in this procedure we may arrive at equations, the coefficients of which, although functions of the roots of the proposed equation, are not symmetrical functions, but partial expressions susceptible of several values, according as the order of the letters that denote the roots is made to vary. On this supposition, the resolution of equations above the fourth order, by means of equations inferior in degree, would not be inconsistent with what has been proved.

Some particular Cases of Equations.

17. A method for solving equations of one order may be generalized so as to extend to a certain class in all orders. Thus De Moivre has found a species of equations of every degree that have their roots similar to those of cubics, and which are solved by the formula

$$x=(q+\sqrt{q^2-p^n})^{\frac{1}{n}}+(q-\sqrt{q^2-p^n})^{\frac{1}{n}},$$

differing in no respect from the expression for resolving cubics, except that n is written in place of 3.

An equation may be depressed to a lower order when it is known that the roots have a given relation to one another. An instance of this has already occurred in the case of equal roots; for, the equal roots having been first found, the equation can be lowered by division. Reciprocal equations furnish another example of depression to a lower order, on account of a relation subsisting among the roots. A reciprocal equation is one of even dimensions, such that half the roots are respectively the reciprocals of the other half, in which case no alteration is produced in the equation when $\frac{1}{x}$ is substituted for x. In equations of this kind, the same coefficients occur in the same order, and with the same signs, reckoning from either end; a description that likewise applies to some equations of odd dimensions, which, however, do not constitute a new class, being merely reciprocal equations, as defined above, multiplied by the factor $x+1$. A reciprocal equation may always be depressed to half the dimensions, by transforming it so that the new unknown quantity shall be equal to $x+\frac{1}{x}$. It is sufficient to have mentioned these cases, which are fully treated of in all the elementary books.

Equations with only two terms, as $x^p-1=o$, are the most extensive class that have been resolved by a general method. The successful application of analysis to this class of equations is extremely interest-

ing both in itself, and likewise because it is connected with the division of the circle into equal parts, and has occasioned the discovery of some curious and unexpected results respecting that problem. For these reasons, it appears proper to lay before our readers a short view of this branch of the doctrine of algebraic equations.

We have already shown, that, admitting the theory of angular sections, every equation with only two terms, as $x^p-1=o$, may be completely resolved into its binomial and trinomial factors; and hence all its roots, possible and impossible, may be computed by means of the trigonometrical tables in common use. If we put $\varphi=\frac{6p°0}{3}$, and denote by k any number less than $\frac{1}{2}p$, we have found that the equation $x^p-1=o$ is divisible by the quadratic factor $x^2-2x.\cos\varphi+1$, and, consequently, that it has the two impossible roots,

$$x=\cos k\varphi+\sin k\varphi.\sqrt{-1}$$
$$x=\cos k\varphi-\sin k\varphi.\sqrt{-1}:$$

and, because $\cos k\varphi=\cos(p-k)\varphi$, and $-\sin k\varphi=\sin(p-k)\varphi$, the same two roots may be otherwise more symmetrically represented, thus,

$$x=\cos k\varphi+\sin k\varphi.\sqrt{-1}$$
$$x=\cos(p-k)\varphi+\sin(p-k)\varphi.\sqrt{-1}.$$

Therefore, when p is odd, the equation $x^p-1=o$ has one real root equal to 1; and when p is even, it has two real roots equal to ± 1; and in both cases the remaining roots are all impossible, and are found from the formula,

$$x=\cos k\varphi+\sin k\varphi.\sqrt{-1},$$

by making k equal to all the integral numbers less than p in the one case, and less than $p-1$ in the other. Nothing, therefore, can be more simple than the computation of the roots of such equations by means of the trigonometrical tables. But in seeking a general solution, it is required to investigate the roots without resorting to the properties of the circle, unless in so far as this may be necessary for solving similar equations inferior in degree to the one proposed. In this view the resolution of the equation $x^p-1=o$, is equivalent to the division of the circle into p equal parts, granting the like division for all numbers less than p. And in order to render the investigation of the problem as simple as possible, it may be further observed, that it will be sufficient to consider the case when the exponent is a prime number; because, from this case, the other, when it is a composite number, can be readily deduced.

It will be proper to premise here a property of the roots of equations with only two terms, to which we shall have occasion continually to refer. The property in question depends upon this theorem, namely: When k is any number, not a multiple of the prime number p, the remainders of the terms of the series,

$$1\times k,\ 2\times k,\ 3\times k\ldots(p-1)\times k,$$

when each is divided by p, are all different from one another; and, consequently, without regard to the order, they will coincide with the numbers 1, 2, 3, &c. less than p. If, therefore, we take any one of the impossible roots of the equation x^{p-1}, viz.

$$r=\cos k\varphi+\sin k\varphi\sqrt{-1},$$

all its powers with indices less than p, viz.

$$r^2=\cos 2k\varphi+\sin 2k\varphi.\sqrt{-1},$$
$$r^3=\cos 3k\varphi+\sin 3k\varphi.\sqrt{-1},$$
&c.

will be different from one another; and likewise they will coincide, without regard to the order, with the like powers of any other impossible root of the same equation: because, whatever number k stands for, the arcs are all different from one another, and, neglecting whole circumferences, constitute the same series of terms although in different orders. Wherefore, p being a prime number, if r be one of the impossible roots of the equation $x^p-1=o$, all the roots will be represented by the terms of the geometrical progression,

$$r^0,\ r^1,\ r^2,\ r^3,\ldots\ldots r^{p-1};$$

for every one of these terms satisfy the given equation, and it has been shown that they are all different from one another.

When p is a composite number, the same property does not belong to all the roots of the equation $x^p-1=o$, but only to some of them. It belongs generally to the root

$$r=\cos k\varphi+\sin k\varphi.\sqrt{-1},$$

when k is either equal to unit, or to any number that has no common divisor with p; in which cases, all the powers of r are roots of the equation $x^p-1=o$, and all different from one another, when the exponents are different and less than p.

If the equation $x^p-1=o$ be divided by the binomial factor $x-1$, we shall get

$$x^{p-1}+x^{p-2}+x^{p-3}\ldots.+x+1=o;$$

and this being a reciprocal equation, it can be farther depressed to half the dimensions. In this manner we obtain the solution of $x^7-1=o$, which is reduced to a cubic; but, by the same procedure, the equation next in order, viz. $x^{11}-1=o$, can be lowered only to the fifth degree, for equations of which class there is no rule. Nevertheless, this last equation has been solved by Vandermonde, to whom, and to Lagrange, we are mainly indebted for disengaging the resolution of equations from the complicated operations of algebra, and for substituting, in their place, reasonings founded on the doctrine of combinations. The author has not explained particularly the process by which his solution was obtained; he gives it as a result of his theory, which, although it fails in general for equations above the fourth degree, succeeds in this instance on account of particular relations between the roots. Similar relations subsist between the roots of any other binomial

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equation when the exponent is a prime number; and, in consequence, a like mode of investigation will apply, as indeed the author has expressly said. But this procedure would unavoidably be attended in every new instance with very long calculations; and it appears hardly possible to arrive in this way at any general method that would apply to all equations of the class in a regular manner, and without considerations drawn from each particular case.

M. Gauss, in a work entitled *Disquisitiones Arithmeticæ*, replete with original and important matter, applied a property of prime numbers to the solution of binomial equations, which removed every difficulty, and led to a theory that unites simplicity and generality. If we suppose that p is a prime number, and resolve $p-1$ into its component factors, so that $p-1=a^{\lambda}.b^{\mu}.c^{\gamma}$. &c., a, b, c, &c. being prime numbers, M. Gauss has proved that the solution of the equation $x^p-1=o$, or, which is the same thing, the division of the circle into p equal parts, can be effected by solving successively λ equations of a dimensions, μ equations of b dimensions, γ equations of c dimensions, &c. Thus, if $p=13$, then, because $13-1=3\times 2^2$, the roots of $x^{13}-1=o$ can be found, or a polygon of 13 sides can be inscribed in a circle, by solving a cubic and two quadratic equations in succession. In certain cases, when a prime number comes under the form 2^n+1, as 17, 257, &c., the division of the circle will require the solution of equations no higher than the second order; whence this unexpected consequence has resulted from the theory of M. Gauss, that the inscription of a polygon of 17, or 257 sides in a circle, which are problems that have always been understood to transcend the limits of the elementary geometry, can, nevertheless, be constructed by the operations admitted in that science.

A work replete with so many interesting discoveries as the *Disquisitiones Arithmeticæ*, could not fail to excite the attention of mathematicians. Legendre, in republishing his *Essay on the Theory of Numbers*, has added to it an exposition of M. Gauss's theory of binomial equations; and the same theory is the subject of the 14th note in the second edition of Lagrange's *Treatise on Numerical Equations*. No part of the mathematics could pass through the hands of men of so much ability without receiving great improvement. Lagrange has shown, that it is not necessary to go through the several intermediate equations that make so essential a part in the investigation of M. Gauss; and, by this means, he has reduced the solution of equations with two terms to the utmost simplicity of which it is capable. But, in one respect, it must be admitted that the procedure of the illustrious geometer is imperfect. Although it arrives, by a short investigation, at the partial quantities that by their additions form the expressions of the roots sought, it leaves indeterminate the order in which they are to be combined. M. Gauss has avoided ambiguity in this respect by deducing from one of the quantities all the other parts of the same expression; but, amidst a multiplicity of different systems of values that may be deduced from the partial quantities, Lagrange has given no clue to guide to the true one.

Equations.

In laying before our readers some account of this interesting branch of the theory of algebraic equations, we shall view the subject in a light somewhat different from that in which it has hitherto been placed. Instead of seeking directly the roots of binomial equations, we shall apply the principles of M. Gauss's theory immediately to the division of the circle into equal parts, by taking the arcs of the circumference in that order, to which the method owes all its success. This procedure is attended with some advantages. In the first place, the algebraic expressions of the quantities sought, represented by $\cos\frac{k\times 360^0}{p}$, are more simple than those of the imaginary roots of the corresponding binomial equation; and, in the second place, the same expressions, having always real values, are better fitted for application than the roots of binomial equations which require to be further reduced to prepare them for calculation.

Before entering on the principal problem, it is necessary to say something of that property of numbers on which the whole theory depends. Supposing p to be any prime number, Euler has distinguished by the name of a *Primitive Root* any number less than $p-1$, such that, if we take the series of all its powers with indices less than p, and in each power reject the multiples of p it contains, the several remainders are all different from one another, and, consequently, paying no regard to the order, they will coincide with the numbers 1, 2, 3, &c. less than p. It has been proved that, for every prime number, there are as many primitive roots as there are numbers less than $p-1$, which have no common divisor with it. The existence of such numbers in every case is therefore demonstrated; but no direct method of finding them has yet been published with which we are acquainted.

We gladly seize the present occasion of laying down a rule for finding the primitive roots of a prime number. But first we must premise, that when any proposed number is said to satisfy the equation $x^m+1=o$, it is always understood that the multiples of the prime number p are rejected; and the meaning is, that, when the given number is substituted for x, the whole result is divisible by p without any remainder.

Now, let p be a prime number, and 2, a, b, c, &c. the prime divisors of $p-1$, so that $p-1=2^{\pi}.a^{\lambda}.b^{\mu}.c^{\gamma}$. &c.: then every primitive root will satisfy the first of the following equations without satisfying any of the rest, viz.

$$x^{\frac{p-1}{2}}+1=o$$

$$x^{\frac{p-1}{2.a}}+1=o$$

$$x^{\frac{p-1}{2b}}+1=o$$
$$x^{\frac{p-1}{2c}}+1=o$$
&c.

And, on the other hand, every number, not a primitive root, which satisfies the first equation, will, at the same time, satisfy one, or more, or all, of the other equations.

But the numbers which satisfy the first equation are exclusively those which are not found among the remainders of the series of square numbers divided by p. Wherefore, setting aside the first equation, if we seek among the non-residual numbers for such as satisfy none of the remaining equations, the numbers so found will be the primitive roots sought.

When one primitive root is found by this method, all the rest may be directly obtained from it. For, if 1, w, w', w'', &c. . . . $w^{(n)}$, represent all the numbers less than $p-1$ and prime to it; then, a being one of the primitive roots, all the roots will be equal to the series of powers,

$$a', a^{w}, a^{w'}, a^{w''} \ldots\ldots a^{w^{(n)}}$$

rejecting always the multiples of p.

The demonstration of these properties would lead us aside from our present purpose; and we shall be content with adding some examples for the sake of illustration.

Let $p=11$; then $\frac{p-1}{2}=5$, and $\frac{p-1}{2.5}=1$; so that in this case, the only equation of exclusion is $x+1=o$, which admits only one solution, viz. $x=p-1=10$. Therefore all the non-residual numbers except 10 are the primitive roots; namely, 2, 6, 7, 8. We may extend this conclusion to every case when $\frac{p-1}{2}$ is a prime number, as 7, 23, 47, &c.; in all which instances all the non-residuals, except $p-1$, are the primitive roots.

Next, let $p=17$; then $\frac{p-1}{2}=8=2^3$; and there are no equations of exclusion. In this case, therefore, all the non-residuals, without exception, are primitive roots; and the same thing is true of every prime number of the form 2^n+1, such as 5, 257, &c.

Let $p=13$; then $\frac{p-1}{2}=2\times 3$; and the only equation of exclusion is

$$x^2+1=o,$$

which admits only two solutions, viz. $x=5$ and $x=8$. In this instance, therefore, all the non-residual numbers, except 5 and 8, are the primitive roots.

Let $p=31$; then $\frac{p-1}{2}=3\times 5$; and we have two equations of exclusion, viz.

$$x^3+1=o$$
$$x^5+1=o.$$

The non-residual numbers are

3, 6, 11, 12, 13, 15, 17, 21, 22, 23, 24, 26, 27, 29, 30.

Of these numbers the first, viz. 3, is a primitive root, since it satisfies neither of the two equations; and as the numbers less than 30, and prime to it, are 1, 7, 11, 13, 17, 19, 23, 29; all the primitive roots of 31 are as follows: viz. $3^1=3$, $3^7=17$, $3^{11}=13$, $3^{13}=24$, $3^{17}=22$, $3^{19}=12$, $3^{23}=11$, $3^{29}=21$. With respect to the other non-residual numbers, it will be found on trial, that the first equation is satisfied by 6 and 26; the second by 15, 23, 27, 29; and both equations by 30.

We are now prepared to enter upon the solution of the problem for dividing the circle into as many equal parts as there are units in the prime number $p=2n+1$. If we conceive a polygon of p sides, to be inscribed in a circle, it will be admitted that the centre of gravity of the polygon coincides with the centre of the circle. Wherefore, if perpendiculars be drawn to any diameter of the circle from all the angles of the polygon, it follows, from the nature of the centre of gravity, that the sum of the cosines lying on one side of the centre of the circle will be equal to the sum of the cosines lying on the other side. Let $\varphi=\frac{360°}{p}$; and put u for the arc intercepted between the diameter and any angle of the polygon, then we shall have this equation, viz.

$$o=\cos u+\cos(\varphi+u)+\cos(2\varphi+u)\ldots+\cos(2n\varphi+u),$$

which is no more than the analytical expression of the geometrical property just mentioned. Now, suppose that the diameter passes through one of the angles of the polygon; then $u=o$, and the equation becomes

$$o=1+\cos\varphi+\cos 2\varphi+\cos 3\varphi\ldots+\cos 2n\varphi.$$

Let a be one of the primitive roots of the prime number p; then rejecting multiples of p, and paying no regard to the order, the terms of the geometrical progression,

$$a, a^2, a^3, a^4 \ldots\ldots a^{2n},$$

will be equal to the several numbers less than p. Wherefore, in the two series of arcs,

$$a\varphi, a^2\varphi, a^3\varphi, a^4\varphi \ldots\ldots a^{2n}\varphi,$$
$$\varphi, 2\varphi, 3\varphi, 4\varphi \ldots\ldots 2n\varphi,$$

every arc in the geometrical progression will either be equal to some one in the arithmetical progression, or will differ from it by a whole circumference, or circumferences. Hence the cosines of the first series of arcs may be substituted in the last equation for the cosines of the other series; and thus we have

$$-1=\cos a\varphi+\cos a^2\varphi+\cos a^3\varphi\ldots+\cos a^{2n}\varphi.$$

Again, by Fermat's theorem, $a^{2n}-1=(a^n+1).(a^n-1)=$a multiple of p; and because no primitive root of a prime number is the remainder of a square divided by that number, we have $a^n+1=$ a multiple of p; and, consequently, $a^{n+\lambda}+a^{\lambda}=$a multiple of

p. It follows, therefore, that $a^{n+\lambda}\varphi+a^{\lambda}\varphi$ is equal to a multiple of the circumference of the circle; and hence,

$$\cos a^{n+\lambda}\varphi=\cos a^{\lambda}\varphi \qquad (A)$$

From this it appears that the cosines in the last equation may be distributed into two equal sums; one containing the cosines of all arcs from $a\varphi$ to $a^n\varphi$ inclusively, and the other the remaining cosines; consequently,

$$-\frac{1}{2}=\cos a\varphi+\cos a^2\varphi+\cos a^3\varphi\ldots\cos a^n\varphi;$$

and because $\cos a^n\varphi=\cos\varphi$,

$$-\frac{1}{2}=\cos\varphi+\cos a\varphi+\cos a^2\varphi\ldots\ldots+\cos a^{n-1}\varphi. \qquad (1)$$

Let $\tau=\frac{360^0}{n}$; and put

$$e=\cos\tau+\sin\tau\sqrt{-1};$$

then all the powers of e with indices less than n will be different from one another, and all of them roots of the equation $e^n-1=0$, the solution of which requires the division of the circle into only n, or $\frac{p-1}{2}$, equal parts.

In what follows, we shall have continual occasion to consider the expression

$\cos a^{\lambda}\varphi+e^m\cos a^{\lambda+1}\varphi+e^{2m}\cos a^{\lambda+2}\varphi\ldots+e^{(n-1)m}\cos a^{\lambda+n-1}\varphi$; and it will, therefore, be convenient to adopt an abridged mode of writing it. Now, the expression will be wholly known, and can be constructed when the two indices λ and m are given; and we may therefore denote it by the symbol $f(\lambda, m)$, placing always the index of a before the other. We shall invariably make the index of a positive, and suppose it reduced below n by means of the formula (A). In like manner we shall suppose that the index of e is always reduced below n by suppressing the multiples of n; and we shall write it sometimes positive and sometimes negative, observing that the negative indices may be always rendered positive by supplying the proper multiples of n; thus, $e^{-im}=e^{n-im}=e^{2n-im}=e^{3n-im}$, &c.

According to the notation just explained, we have

$$f(o,m)=\cos\varphi+e^m\cos a\varphi+e^{2m}\cos a^2\varphi\ldots+e^{(n-1)m}\cos a^{n-1}\varphi,$$

$$f(o,-m)=\cos\varphi+e^{-m}\cos a\varphi+e^{-2m}\cos a^2\varphi\ldots+e^{-(n-1)m}\cos a^{n-1}\varphi.$$

And because $e^0=e^n=e^{-n}=1$, the symbols $f(o,o)$, $f(o,n)$, $f(o,-n)$, will represent the series of cosines in the equation (1); so that we have

$$-\frac{1}{2}=f(o,o)=f(o,n)=f(o,-n).$$

The following formula is no more than a corollary from the preceding notation, viz.

$$e^{-\lambda m}\times f(o,m)=f(\lambda,m). \qquad (B)$$

By means of the trigonometrical formula in common use, any powers and products of the cosines of the arc φ and its multiples may be reduced to a series of terms, containing the like cosines multiplied by given coefficients. Wherefore, because $\cos p\varphi=1$, and likewise, because the cosines of all arcs greater than $p\varphi$, $2p\varphi$, $3p\varphi$, &c. may be reduced to the cosines of arcs less than $p\varphi$, it follows that every rational and integral function of $\cos\varphi$, $\cos 2\varphi$, $\cos 3\varphi$, &c. may be brought under this form of expression, viz.

$$A+B\cos\varphi+C\cos 2\varphi+D\cos 3\varphi\ldots+N\cos 2n\varphi.$$

Now, if we suppose the function we are considering to be such, that it retains the same value when any of the multiple arcs 2φ, 3φ, &c. is substituted for φ, the transformed expression will be possessed of the same property. But, if we actually substitute the arcs 2φ, 3φ, &c. for φ in the foregoing expression, it will become successively

$$A+B\cos 2\varphi+C\cos 4\varphi+D\cos 6\varphi+\&c.$$
$$A+B\cos 3\varphi+C\cos 6\varphi+D\cos 9\varphi+\&c.$$
&c.

each line containing the same cosines, although in a different order, because the series of arcs is the same when whole circumferences, or the multiples of $p\varphi$ are rejected; and all these expressions cannot have the same value unless $B=C=D=$&c.; that is, unless the expression be of this form, viz.

$$A+B(\cos\varphi+\cos 2\varphi+\cos 3\varphi\ldots+\cos 2n\varphi),$$

which, in consequence of what was before proved, is equal to $A-B$. It is, therefore, demonstrated that every rational and integral function of $\cos\varphi$, $\cos 2\varphi$, $\cos 3\varphi$, &c., which remains unchanged when any of the multiple arcs 2φ, 3φ, &c. is substituted for φ, has, for its value, an expression without cosines, and depending only upon the nature of the function.

If we introduce the arcs in geometrical, instead of those in arithmetical progression, it is obvious that the substitution of the multiple arcs 2φ, 3φ, &c., for φ, is equivalent to the changing of φ into $a\varphi$, $a^2\varphi$, $a^3\varphi$, &c.; and hence any rational and integral function of the cosines of φ and its multiples, which remains invariable when φ is changed into $a\varphi$, $a^2\varphi$, $a^3\varphi$, &c. is a quantity independent of the cosines, or has its value expressed by a function from which the cosines are eliminated.

What has now been proved will enable us to appreciate the advantage arising from the introduction of the arcs in geometrical, in place of those in arithmetical progression, in which principally consists the improvement that this theory owes to M. Gauss. The solution of the problem turns upon finding those functions of $\cos\varphi$, $\cos 2\varphi$, $\cos 3\varphi$, &c. which have determinate values independent of the cosines; which functions, it has been proved, remain invariable when any of the multiple arcs 2φ, 3φ, &c. is substituted for φ. Now, although the substitution of any multiple arc, in place of the arc itself, always reproduces the same series of cosines, yet the order is irregular, and varies with every different multiple arc; and this circumstance makes it difficult to investigate what

change the substitution will effect in a given function. On the other hand, by introducing the arcs in geometrical progression, the same order is still preserved, whatever substitution be made; and, by this means, every facility possible is obtained for investigating the functions sought.

The following properties are deducible from what has been proved. First, if m, m', m'', &c. be any numbers, none of which is equal to zero, or a multiple of n, and such that their sum is equal to n, or to a multiple of n; the product

$$f(o\,,m)\times f(o\,,m')\times f(o\,,m'')\ \&c.$$

will be independent of the cosines of φ and its multiples, or will be an expression containing only the powers of e multiplied by numeral coefficients.

For by the formula (B) we have

$$-e^{\lambda m}\times f(o\,,m)=f(\lambda\,,m)$$
$$e^{-\lambda m'}\times f(o\,,m')=f(\lambda\,,m')$$
$$e^{-\lambda m''}\times f(o\,,m'')=f(\lambda\,,m'')$$
$$\&c. \qquad \&c.$$

Therefore, by multiplying and observing that $e^{-\lambda m}\times e^{-\lambda m'}\times e^{-\lambda m''}\times\&c.=1$, because $\lambda\times(m+m'+m''+\&c.)$ is a multiple of n, we get

$$f(o\,,m)\times f(o\,,m')\times f(o\,,m'')\ \&c.=f(\lambda\,,m)\times f(\lambda\,,m')\times f(\lambda\,,m'')\ \&c.$$

which shows that the product in question is not altered when φ is changed into $a^{\lambda}\varphi$. Consequently, according to what was before proved, the product is independent of the cosines.

It follows, as a corollary, that the product

$$f(o\,,m)\times f(o\,,-m)$$

is independent of the cosines.

Next, if m, m', m'', &c. be any numbers, and $s=m+m'+m''$ &c.; and if neither s nor any of the numbers m, m', m'', &c. be a multiple of n, we shall have

$$f(o\,,m)\times f(o\,,m')\times f(o\,,m'')\ \&c.=\mathrm{M}\times f(o\,,s),$$

the quantity M being independent of the cosines, and containing only the powers of e multiplied by numeral coefficients.

For, by the property already demonstrated, and its corollary, we have

$$f(o\,,m)\times f(o\,,m')\times f(o\,,m'')\times f(o,-s)=\mathrm{A}$$
$$f(o,s)\times f(o,-s)=\mathrm{A}';$$

A and A′ being quantities independent of the cosines. Therefore, by exterminating $f(o,-s)$, we get

$$f(o,m)\times f(o,m')\times f(o,m'')\times\&c.=\frac{\mathrm{A}}{\mathrm{A}'}.f(o\,,s).$$

The foregoing properties are the foundations of the theory. But it is not enough to establish the principles by a general demonstration: it is also necessary to be able to compute the numerical values that occur in the application to particular problems. Therefore, supposing that m and m' are two numbers, and $s=m+m'$, none of the three numbers s, m, m', being a multiple of n, it is proposed to find the value of A in the equation.

$$f(o\,,m)\times f(o\,,m')=\mathrm{A}\times f(o\,,s).$$

For this purpose, set down the several terms of $f(o\,,m')$ in their order; and below them write the terms of $f(o\,,m)$, placing first any term, as $e^{\lambda m}\cos a^{\lambda}\varphi$, and the rest in their order, in this manner,

$$\cos\varphi+e^{m'}\cos a\varphi+e^{2m'}\cos a^2\varphi\ \ldots\ldots+e^{(n-1)m'}\cos a^{n-1}\varphi$$

$$e^{\lambda m}\cos a^{\lambda}\varphi+e^{(\lambda+1)m}\cos a^{\lambda+1}\varphi+e^{(\lambda+2)m}\cos a^{\lambda+2}\varphi\ldots+e^{(\lambda+n-1)m}\cos a^{\lambda+n-1}\varphi.$$

Now, let every term in the lower line be multiplied into that which stands above it; and, separating the factor $e^{\lambda m}$, which is common to each product, let the symbol $e^{\lambda m}\times\Psi(\lambda)$ represent the sum of all the products; then

$$\Psi(\lambda)=$$
$$\cos\varphi\cos a^{\lambda}\varphi+e^{s}\cos a\varphi\cos a^{\lambda+1}\varphi\ \ldots\ldots+e^{(n-1)s}\cos a^{n-1}\varphi\cos a^{\lambda+n-1}\varphi.$$

If we repeat this operation, so as to make every term of the lower line stand first in succession, it is evident that, by this means, every term of $f(o,m')$ will be multiplied by all the terms of $f(o,m)$; so that the sum of all the results will be the product sought. We therefore obtain

$$f(o,m)\times f(o,m')=$$
$$\Psi(o)+e^{m}\Psi(1)+e^{2m}\Psi(2)\ldots+e^{(n-1)m}\Psi(n-1).$$

Let $a^{\lambda}+1=w$, and $a^{\lambda}-1=w'$; then because the product of the cosines of two arcs is equal to half the sum of the cosines of the sum and difference of the two arcs, we shall have

$$\Psi(\lambda)=$$
$$\frac{1}{2}\left\{\cos w\varphi+e^{s}\cos a\,.\,w\varphi+e^{2s}\cos a^2\,.\,w\varphi+\&c.\right\}$$
$$+\frac{1}{2}\left\{\cos w'\varphi+e^{s}\cos a\,.\,w'\varphi+e^{2s}\cos a^2\,.\,w'\varphi+\&c.\right\}.$$

In the first place, when $\lambda=o$, $w=2$, $w'=o$; therefore,

$$\Psi(o)=$$
$$\frac{1}{2}\left\{\cos 2\varphi+e^{s}\cos a\,.\,2\varphi+e^{2s}\cos a^2\,.\,2\varphi\ \ldots\ +e^{(n-1)s}\cos a^{n-1}\,.\,2\varphi\right\}$$
$$+\frac{1}{2}\left\{1+e^{s}+e^{2s}+e^{3s}\ \ldots\ +e^{(n-1)s}\right\}.$$

But $e^{n}-1=o$; and hence $e^{ns}-1=o$; or

$$o=(1-e^{s})\,.\left\{1+e^{s}+e^{2s}+\&c.\ \ldots\ +e^{(n-1)s}\right\}:$$

and, according to the value assumed for e, the equation $1-e^{s}=o$ cannot take place when s is not a multiple of n; wherefore

$$o=1+e^{s}+e^{2s}+e^{3s}\ \ldots\ +e^{(n-1)s}.$$

Now, if we put $a^{i}=2$, we shall get

$$\Psi(o)=\frac{1}{2}f(i,s)=$$

$$\frac{1}{2}\left\{\cos . a^i\varphi + e^s \cos a^{i+1}\varphi + e^{2s}\cos a^{i+2}\varphi + \&c.\right\}.$$

Wherefore, on account of the formula (B), we finally get

$$\Psi(o) = \frac{1}{2}e^{-is} \times f(o,s).$$

Next, when λ is not equal to zero, let $h(\lambda)$ and $h'(\lambda)$ denote the numbers derived from λ by means of the equations

$$a^\lambda + 1 = a^{h(\lambda)}$$

$$a^\lambda - 1 = a^{h'(\lambda)}:$$

then, by substituting $a^{h(\lambda)}$ and $a^{h'(\lambda)}$ for w and w', we shall get

$$\Psi(\lambda) = \frac{1}{2}f\Big(h(\lambda),s\Big) + \frac{1}{2}f\Big(h'(\lambda),s\Big);$$

and on account of the formula (B),

$$\Psi(\lambda) = \left\{\frac{1}{2}e^{-(\lambda)s} + \frac{1}{2}e^{-h'(\lambda)s}\right\} . f(o,s).$$

Now, collecting all the parts in the expression of $f(o,m) \times f(o,m')$, we shall get these formulæ, viz.

$$\left.\begin{aligned} & f(o,m) \times f(o,m') = \mathrm{A} \times f(o,s) \\ & \mathrm{A} = \frac{1}{2}e^{-is} + \frac{1}{2}e^{m-h(1)s} + \frac{1}{2}e^{m-h'(1)s} \\ & \qquad + \frac{1}{2}e^{2m-h(2)s} + \frac{1}{2}e^{2m-h'(2)s} \\ & \qquad + \frac{1}{2}e^{3m-h(3)s} + \frac{1}{2}e^{3m-h'(3)s} \\ & \qquad \&c. \qquad \&c. \end{aligned}\right\} (2)$$

As nothing changes in the expression of A except the indices m and s, it may be denoted by the abridged symbol (m,s), in which it is obvious that m' may be substituted for m; so that

$$\mathrm{A} = (m,s) = (m',s).$$

When s is equal to n, and $m' = n - m$, the product in question becomes $f(o,m) \times f(o,-m)$, which has been proved to be a quantity independent of the cosines. In this case, therefore, we shall have

$$f(o,m) \times f(o,-m) = \mathrm{B};$$

B being a quantity from which the cosines are eliminated, and which is now to be investigated.

If, in the foregoing case, we suppose $m' = n - m$ and $s = n$, we shall get

$$f(o,m) \times f(o,-m) =$$

$$\Psi(o) + e^m\Psi(1) + e^{2m}\Psi(2) \ldots e^{(n-1)m}\Psi(n-1):$$

but here, because $e^s = e^n = 1$, e and its powers disappear from the expression of $\Psi(\lambda)$, and we have

$$\Psi(\lambda) =$$

$$\cos\varphi \cos a^\lambda\varphi + \cos a\varphi \cos a^{\lambda+1}\varphi + \cos a^2\varphi \times \cos a^{\lambda+2}\varphi + \&c.;$$

and, by expanding the products of the cosines, as before,

$$\Psi(\lambda) =$$

$$\frac{1}{2}\left\{\cos w\varphi + \cos a . w\varphi + \cos a^2 w\varphi \ldots + \cos a^{n-1} . w\varphi\right\}$$

$$+ \frac{1}{2}\left\{\cos w'\varphi + \cos a . w'\varphi + \cos a^2 . w'\varphi \ldots + \cos a^{n-1} . w'\varphi\right\}.$$

When $\lambda = o, w = 2, w' = o$; therefore

$$\Psi(o) =$$

$$\frac{1}{2} . \left\{\cos 2\varphi + \cos a . 2\varphi + \cos a^2 . 2\varphi \ldots + \cos a^{n-1} . 2\varphi\right\}$$

$$+ \frac{1}{2}\left\{1 + 1 + 1 + 1 + 1 \ldots\ldots + 1\right\}.$$

But no alteration is made in equat. (1) when we substitute, instead of the arc φ, any one of its multiples, or, which is the same thing, change φ into $a\varphi$, $a^2\varphi$, &c.; because such substitution, or change, continually reproduces the same cosines. Thus it appears that the sum of the n cosines in $\Psi(o)$, is equal to $-\frac{1}{2}$; and we have

$$\Psi(o) = \frac{n}{2} - \frac{1}{4}.$$

For every other value of λ, w and w' are, neither of them, equal to zero, nor to a multiple of n; wherefore, according to what has just been said, the sum of the n cosines in each of the two parts of $\Psi(\lambda)$, is equal to $-\frac{1}{2}$; and thus, when λ is not equal to zero, we have

$$\Psi(\lambda) = \frac{1}{2} \times -\frac{1}{2} + \frac{1}{2} \times -\frac{1}{2} = -\frac{1}{2}.$$

By substituting the values of $\Psi(o)$ and $\Psi(\lambda)$, we get

$$f(o,m) \times f(o,-m) =$$

$$\frac{n}{2} - \frac{1}{4} - \frac{1}{2}\Big(e^m + e^{2m} + e^{3m} \ldots + e^{(n-1)m}\Big).$$

But, as was already proved,

$$-1 = e^m + e^{2m} + e^{3m} \ldots + e^{(n-1)m}:$$

wherefore,

$$f(o,m) \times f(o,-m) = \frac{n}{2} - \frac{1}{4} + \frac{1}{2} = \frac{2n+1}{4} = \frac{1}{4}p.$$

Now, if we put $k^2 = \frac{1}{4}p$, we have finally

$$f(o,m) \times f(o,-m) = k^2 \ldots (3).$$

When n is an even number, it is obvious that $f\left(o,\frac{n}{2}\right) = f\left(o,-\frac{n}{2}\right)$: therefore it follows as a corollary, that, in this case,

$$f\left(o,\frac{n}{2}\right)=f\left(o,-\frac{n}{2}\right)=\pm k=\pm\frac{1}{2}\sqrt{p.}$$

By applying the equat. (2) first to the indices m and m', and then to the indices $n-m$ and $n-m'$, or to m and m' taken negatively, we deduce

$$f(o,m)\times f(o,m')=(m,s)\times f(o,s)$$
$$f(o,-m)\times f(o,-m')=(-m,-s)\times f(o,-s):$$

and, by multiplying, we shall get, on account of equat. (3), this remarkable formula, viz.

$$(m,s)\times(-m,-s)=k^2\ldots(4).$$

By successive applications of the equat. (2), we get

$$f(o,1)\times f(o,1)=(1,2)\times f(o,2)$$
$$f(o,1)\times f(o,2)=(1.3)\times f(o,3)$$
$$f(o,1)\times f(o,3)=(1,4)\cdot f(o,4)$$
&c.

By combining these equations, and writing P for $f(o,1)$, we deduce

$$P^2=(1,2)\cdot f(o,2)$$
$$P^3=(1,2)\cdot(1,3)\cdot f(o,3)$$
$$P^4=(1,2)\cdot(1,3)\cdot(1,4)\cdot f(o,4)$$
&c.

Wherefore, when n is an even number,

$$P^{\frac{n}{2}}=(1,2).(1,3).(1,4)\ldots\ldots\left(1,\frac{n}{2}\right).f\left(o,\frac{n}{2}\right);$$

and, by squaring and observing that, by equation (3), $\left\{f\left(o,\frac{n}{2}\right)\right\}^2=k^2$, we get

$$P^n=(1,2)^2.(1,3)^2.(1,4)^2\ldots\left(1,\frac{n}{2}\right)^2.k^2. \qquad (5).$$

When n is an odd number, we have in like manner,

$$P^{\frac{n-1}{2}}=(1,2).(1,3).(1,4)\ldots\left(1,\frac{n-1}{2}\right)\times f\left(o,\frac{n-1}{2}\right)$$

$$P^{\frac{n+1}{2}}=(1,2).(1,3).(1,4)\ldots\left(1,\frac{n+1}{2}\right)\times f\left(o,\frac{n+1}{2}\right);$$

but, by equation (3), $f\left(o,\frac{n-1}{2}\right)\times f\left(o,\frac{n+1}{2}\right)=k^2$; wherefore

$$P^n=(1,2)^2.(1,3)^2.(1,4)^2\ldots\ldots\left(1,\frac{n-1}{2}\right)^2.\left(1,\frac{n+1}{2}\right).k^2\ldots(6).$$

Again, from the preceding expressions we get

$$f(o,2)=\frac{1}{(1,2)}\cdot P^2;$$

and, by equation (4),

$$f(o,2)=\frac{(-1,-2)}{k^2}\cdot P^2.$$

In like manner,

$$f(o,3)=\frac{(-1,-2)}{k^2}\cdot\frac{(-1,-3)}{k^2}\cdot P^3$$

$$f(o,4)=\frac{(-1,-2)}{k^2}\cdot\frac{(-1,-3)}{k^2}\cdot\frac{(-1,-4)}{k^2}\cdot P^4,$$
&c.

These formulæ need only be continued till we obtain the value of the function $\left(o,\frac{n-2}{2}\right)$ when n is even, and of $f\left(o,\frac{n-1}{2}\right)$ when n is odd; the remaining functions $f(o,n-2)$, $f(o,n-3)$ &c. or, which is the same thing, $f(o,-2)$, $f(o,-3)$ &c. being derived from the preceding values merely by changing the signs of the different indices of e. Thus, if we write P′ for $f(o,-1)$, we shall have

$$f(o,-2)=\frac{(1,2)}{k^2}\cdot P'^2$$

$$f(o,-3)=\frac{(1,2)}{k^2}\cdot\frac{(1,3)}{k^2}\cdot P'^3$$

$$f(o,-4)=\frac{(1,2)}{k^2}\cdot\frac{(1,3)}{k^2}\cdot\frac{(1,4)}{k^2}\cdot P'^4$$
&c.

Now, ϱ being any number less than n, it has been shown that

$$o=1+e^{\varrho}+e^{2\varrho}+e^{3\varrho}\ldots+e^{(n-1)\varrho}:$$

and hence if we attend to the nature of functions, $f(o,o)$, $f(o,1)$, $f(o,2)$, &c. we shall readily get

$$\cos a^{\varrho}\varphi=$$
$$\frac{f(o,o)}{n}+\frac{1}{n}\cdot\left\{e^{-\varrho}.f(o,1)+e^{-2\varrho}\ f(o,2)+e^{-3\varrho}\ f(o,3)+\text{\&c.}\right\};$$

or, by arranging the terms differently, and because $f(o,o)=-\frac{1}{2}$,

$$\cos a^{\varrho}\varphi=-\frac{1}{2n}+\frac{1}{n}\cdot\left\{e^{-\varrho}f(o,1)+e^{\varrho}.f(o,-1)\right\}$$
$$+\frac{1}{n}\cdot\left\{e^{-2\varrho}.f(o,2)+e^{2\varrho}.f(o,-2)\right\}$$
$$+\frac{1}{n}\cdot\left\{e^{-3\varrho}.f(o,3)+e^{3\varrho}\ f(o,-3)\right\}$$
&c.

and it is to be observed that, when n is even, the last term is the single quantity $\frac{1}{n}\times e^{-\frac{n}{2}\varrho}\times f\left(o,\frac{n}{2}\right)$, which has no corresponding part. Now, this quantity is entirely known. For, since $e^n=1$, we have

Equations.

$e^{\frac{n}{2}}=e^{-\frac{n}{2}}=\pm 1$; but e has been so assumed, that none of its powers with indices less than n are equal to unit; and, therefore, $e^{-\frac{n}{2}}=-1$, and $e^{-\frac{n}{2}\varrho}=(-1)^{\varrho}$. Again, by equation (3), $f\left(o, \frac{n}{2}\right)=\pm k$; wherefore we have

$$\frac{1}{n}\cdot e^{-\frac{n}{2}\varrho}\cdot f\left(o, \frac{n}{2}\right)=\frac{1}{n}\cdot(-1)^{\varrho}\cdot \times \pm k.$$

On the whole, the preceding analysis brings us to the following formulæ, which contain the solution of the problem, viz.

when n is even by equation (5),

$$P^{\frac{n}{2}}=(1,2)\cdot(1,3)\cdot(1,4)\ldots\left(1,\frac{n}{2}\right)\times\pm k;$$

when n is odd, by equation (6),

$$P^{n}=(1,2)^2\cdot(1,3)^2\cdot(1,4)^2\ldots\left(1,\frac{n-1}{2}\right)^2\cdot\left(1,\frac{n+1}{2}\right)\cdot k^2;$$

and by equation (2), $PP'=k^2$.

Finally, by substituting the values of $f(o,2)$, $f(o,3)$, &c. $f(o,-2)$, $f(o,-3)$, &c. in the expression of $\cos a^{\varrho}\varphi$, we get

$$\cos a^{\varrho}\varphi=-\frac{1}{2n}+\frac{k}{n}\cdot\left\{\frac{e^{-\varrho}P}{k}+\frac{e^{\varrho}P'}{k}\right\}$$
$$+\frac{k}{n}\cdot\left\{\frac{(-1,-2)}{k}\cdot\left(\frac{e^{-\varrho}P}{k}\right)^2+\frac{(1,2)}{k}\cdot\left(\frac{e^{\varrho}P'}{k}\right)^2\right\}$$
$$+\frac{k}{n}\cdot\left\{\frac{(-1,-2)}{k}\cdot\frac{(-1,-3)}{k}\cdot\left(\frac{e^{-\varrho}P}{k}\right)^3+\frac{(1,2)}{k}\cdot\frac{(1,3)}{k}\left(\frac{e^{\varrho}P'}{k}\right)^3\right\}$$
$$+\ \&c.$$

the series of terms must be continued till the last index of $\frac{e^{-\varrho}P}{k}$ and $\frac{e^{\varrho}P'}{k}$ is $\frac{n-1}{2}$ when n is odd, and $\frac{n-2}{2}$ when n is even; and, in this last case, the quantity $\frac{1}{n}\times(-1)^{\varrho}\times\pm k$, must be added, prefixing to k the same sign that is given to it in the value of $P^{\frac{n}{2}}$.

The solution of the problem is thus reduced to the computation of the functions (1, 2), (1, 3), &c. which requires no more than the substitution of 1 for m, and of 2, 3, 4, &c. successively for s, in the expression of A, equation (2). The half of these functions that have negative indices are deduced from the other half, merely by changing the signs of the several indices of e, or by means of equation (4). All the cosines sought are found by substituting o, 1, 2, 3, &c. successively for ϱ. Although the function P is susceptible of n different values, represented by x, ex, e^2x, &c.; yet the same cosines are deduced from any one of these values. By this means all ambiguity is avoided with regard to the system of values that represent the cosines; but the numerical value that must be attached to each particular cosine remains quite indeterminate, because φ may equally stand for $\frac{360^0}{p}$, $2\times\frac{360^0}{p}$, $3\times\frac{360^0}{p}$, &c. The adaptation of the numerical quantities to the geometrical cosines must be made out by means of their relative magnitudes; the largest number answering to the greatest cosine. But when the value of one cosine is fixed, the rest are unambiguously determined by means of their indices.

In the formula for $\cos a^{\varrho}\varphi$ all the terms in which two quantities are combined have real values, although their forms are imaginary. But it is not difficult to transform them into equivalent quantities without the imaginary sign.

It is manifest that the functions (1, 2) and (—1, —2) are of this form, viz.

$$(1,2)=A+Be+Ce^2+De^3\ldots+Ne^{n-1}$$
$$(-1,-2)=A+Be^{-1}+Ce^{-2}+De^{-3}\ldots+Ne^{-(n-1)},$$

A, B, C, &c. denoting given coefficients.

But, we have generally

$$e^{\lambda}=\cos\lambda\tau+\sin\lambda\tau\sqrt{-1}$$
$$e^{-\lambda}=\cos\lambda\tau-\sin\lambda\tau\sqrt{-1}:$$

wherefore, by combining the two expressions of (1, 2) and (—1, —2), we shall readily get

$$\frac{(1,2)+(-1,-2)}{2}=A+B\cos\tau+C\cos 2\tau+\ \&c.$$
$$\frac{(1,2)-(-1,-2)}{2}=\quad B\sin\tau+C\sin 2\tau+\ \&c.$$

But, on account of equation (4), we may assume

$$(1,2)=k(\cos\beta+\sin\beta\sqrt{-1})$$
$$(-1,-2)=k(\cos\beta-\sin\beta\sqrt{-1});$$

and, by substituting these values in the last expressions, we get

$$k\cos\beta=A+B\cos\tau+C\cos 2\tau+\ \&c.$$
$$k\sin\beta=\quad B\sin\tau+C\sin 2\tau+\ \&c.$$

by which means the arc β is determined without ambiguity, since both its sine and cosine are ascertained. In like manner are determined the several arc in the formulæ,

$$(1,3)=k(\cos\beta'+\sin\beta'\sqrt{-1})$$
$$(-1,-3)=k(\cos\beta'-\sin\beta'\sqrt{-1})$$
$$(1,4)=k(\cos\beta''+\sin\beta''\sqrt{-1})$$
$$(-1,-4)=k(\cos\beta''-\sin\beta''\sqrt{-1})$$
$$\&c.$$

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Again, because $PP'=k^2$, we may assume

$$P=k(\cos w+\sin w\sqrt{-1})$$
$$P'=k(\cos w-\sin w\sqrt{-1}):$$

And if these values, and the similar values of the functions(1, 2), (1, 3), &c. be substituted in the value of $P^{\frac{n}{2}}$, we shall readily deduce, when n is an even number,

$$\frac{n}{2}\cdot w=\beta+\beta'+\beta''+\ \&c.$$

When n is an odd number, we must separate the function $\left(1, \frac{n+1}{2}\right)$ from the rest, by supposing

$$\left(1, \frac{n+1}{2}\right)=k\,(\cos\gamma+\sin\gamma\sqrt{-1}):$$

and then, by means of equation (6), we shall easily obtain

$$nw=2(\beta+\beta'+\beta''+\&c.)+\gamma.$$

The two last formulæ determine the arc w; and we likewise have

$$\frac{e^{-\varrho}P}{k}=\cos(w-\varrho\tau)+\sin(w-\varrho\tau)\sqrt{-1}$$

$$\frac{e^{\varrho}P'}{k}=\cos(w-\varrho\tau)-\sin(w-\varrho\tau)\sqrt{-1};$$

and, by putting $w^{(\varrho)}=w-\varrho\tau$,

$$\frac{e^{-\varrho}P}{k}=\cos w^{(\varrho)}+\sin w^{(\varrho)}\sqrt{-1}$$

$$\frac{e^{\varrho}P}{k}=\cos w^{(\varrho)}-\sin w^{(\varrho)}\sqrt{-1}.$$

Finally, by substituting the different values exhibited above in the formula for $\cos a^{\varrho}\varphi$, we shall get

$$\begin{aligned}\cos a^{\varrho}\varphi=&-\frac{1}{2n}+\frac{2k}{n}\cdot\cos w^{(\varrho)}\\&+\frac{2k}{n}\cdot\cos(2w^{\varrho}-\beta)\\&+\frac{2k}{n}\cdot\cos(3w^{(\varrho)}-\beta-\beta')\\&+\frac{2k}{n}\cdot\cos(4w^{(\varrho)}-\beta-\beta'-\beta'')\\&\&c.\end{aligned}$$

the series of terms being continued till all the arcs β, β', β'', &c. are taken in when n is odd; and till they are all taken in except the last when n is even, in which case also the quantity $(-1)^{\varrho}\cdot\frac{k}{n}$ must be added.

By the preceding analysis the division of the circle into p equal parts is accomplished, when p is a prime number, by dividing a given arc into n or $\frac{p-1}{2}$ equal parts. And this conclusion agrees with the general proposition of M. Gauss. For the nth part of a given arc is found by bisecting as often as n is divisible by 2, trisecting as often as it is divisible by 3, and so on. When n is a power of two, as in the case of the polygon of 17 sides, the solution is effected by repeated bisections, and thus comes under the elementary geometry. Supposing the division of the circle to be accomplished, we must further resolve the quadratic equation

$$x+\frac{1}{x}=2\cos\cdot\frac{\lambda\times 360^{\circ}}{p},$$

in order to find the roots of the binomial equation $x^p-1=o$.

The following examples are subjoined for the sake of illustrating the method of calculation. And, in the first place, we may take the case of $p=11$ equivalent to finding the roots of the equation $x^{11}-1=o$, which was first solved by Vandermonde, and has been considered both by Lagrange and Legendre. Here,

$$n=5;\ k=\frac{1}{2}\sqrt{11};\ \tau=\frac{360^{\circ}}{5}=72^{\circ};\ e=\cos\tau+\sin\tau\sqrt{-1};$$

and, as 2 is a primitive root of 11, we may suppose $a=2$. In order to find the numbers $h(\lambda)$ and $h'(\lambda)$, write down the series 1, 2, 3, &c. as far as n or 5; and, above each number, write the power of a equal to it when the multiples of 11 are rejected, taking always the least remainder, whether positive or negative: thus,

$$\begin{matrix}a^0 & a^1 & a^3 & a^2 & a^4\\ 1 & 2 & 3 & 4 & 5.\end{matrix}$$

In this arrangement of the powers of a, it is evident that, λ denoting any index, $h(\lambda)$ is the next on the right hand, and $h'(\lambda)$ the next on the left hand: we have, therefore,

$$i=1$$
$$\begin{matrix}h(1)=3 & h'(1)=o\\ h(2)=4 & h'(2)=3\\ h(3)=2 & h'(3)=1\\ h(4)=4 & h'(4)=2.\end{matrix}$$

Now, substitute these numbers in the expression of A, equat. (2), and likewise put $m=1$; then,

$$\begin{aligned}A=&\frac{1}{2}e^{-s}+\frac{1}{2}e^{1-3s}+\frac{1}{2}e\\&+\frac{1}{2}e^{2-4s}+\frac{1}{2}e^{2-3s}\\&+\frac{1}{2}e^{3-2s}+\frac{1}{2}e^{3-s}\\&+\frac{1}{2}e^{4-4s}+\frac{1}{2}e^{4-2s}.\end{aligned}$$

In order to find (1, 2) and (1, 3) we have only to substitute 2 and 3 for s in the expression of A; hence

$$(1,2)=1+2e+\frac{1}{2}e^3+e^4$$

$$(1,3)=1+\frac{1}{2}e+2e^2+e^3;$$

which values will, in this case, be rendered some-

what more simple by combining them with the equation $o=1+e+e^2+e^3+e^4$: and thus we get

$$(1,2)=e-e^2-\frac{1}{2}e^3=m$$

$$(1,3)=e^2-e^4-\frac{1}{2}e=\mu.$$

The functions $(-1,-2)$ and $(-1,-3)$ are found by subtracting the indices of e in the values of $(1,2)$ and $(1,3)$ from 5, which is equivalent to changing the signs of the indices: therefore,

$$(-1,-2)=e^4-e^3-\frac{1}{2}e^2=m'$$

$$(-1,-3)=e^3-e-\frac{1}{2}e^4=\mu':$$

And it will be found, by actually multiplying, that $mm'=k^2=\frac{11}{4}$ and $\mu\mu'=k^2=\frac{11}{4}$.

These values being found, we have, according to the foregoing method,

$$P^5=(1,2)^2.(1,3).k^2=m^2\mu.k^2$$

$$P'^5=\frac{k^{10}}{P^5}=(-1,-2)^2.(-1,-3).k^2=m'^2\mu'.k^2:$$

and hence $\frac{P}{k}=\frac{1}{k}(m^2\mu.k^2)^{\frac{1}{5}}$

$$\frac{P'}{k}=\frac{1}{k}(m'^2\mu'.k^2)^{\frac{1}{5}}$$

$$\frac{m'}{k}.\frac{P^2}{k^2}=\frac{1}{k}(m'\mu^2.k^2)^{\frac{1}{5}}$$

$$\frac{m}{k}.\frac{P'^2}{k^2}=\frac{1}{k}(m\mu'^2.k^2)^{\frac{1}{5}};$$

wherefore we have

$$\cos a^{\varrho}\varphi=-\frac{1}{10}+\frac{e^{-\varrho}}{5}.(m^2\mu.k^2)^{\frac{1}{5}}+\frac{e^{\varrho}}{5}.(m'^2\mu'.k^2)^{\frac{1}{5}}+\frac{e^{-2\varrho}}{5}.(m'\mu^2.k^2)^{\frac{1}{5}}+\frac{e^{2\varrho}}{5}.(m\mu'^2.k^2)^{\frac{1}{5}}.$$

If, in this expression, we make $\varrho=o$, and substitute the numerical values of k^2, and of e and its powers, in the quantities under the radical sign, the result will coincide with the formula of Vandermonde, and with the calculation of Lagrange.

The expression just found being imaginary, if it be required to reduce it to a form fit for calculation, we must begin with substituting the values of e and its powers in m and μ: then

$$m=(\cos\tau-\cos 2\tau-\frac{1}{2}\cos 3\tau)+(\sin\tau-\sin 2\tau-\frac{1}{2}\sin 3\tau).\sqrt{-1}$$

$$\mu=(\cos 2\tau-\cos 4\tau-\frac{1}{2}\cos\tau)+(\sin 2\tau-\sin 4\tau-\frac{1}{2}\sin\tau).\sqrt{-1}.$$

Now, $\cos\tau=\cos 4\tau=-\frac{1}{4}+\frac{1}{4}\sqrt{5}$, and $\cos 2\tau=\cos 3\tau=-\frac{1}{4}-\frac{1}{4}\sqrt{5}$; also $\sin\tau=-\sin 4\tau$, and $\sin 2\tau=-\sin 3\tau$: wherefore,

$$m=(\cos\tau-\frac{3}{2}\cos 2\tau)+(\sin\tau-\frac{1}{2}\sin 2\tau).\sqrt{-1}$$

$$\mu=(\cos 2\tau-\frac{3}{2}\cos\tau)+(\sin 2\tau+\frac{1}{2}\sin\tau).\sqrt{-1}.$$

Again,

$$m=k(\cos\beta+\sin\beta.\sqrt{-1})$$

$$\mu=k(\cos\gamma+\sin\gamma\sqrt{-1});$$

consequently,

$$\cos\beta=\frac{1}{k}(\cos\tau-\frac{3}{2}\cos 2\tau)=\frac{1+5\sqrt{5}}{4\sqrt{11}},$$

$$\sin\beta=\frac{1}{k}(\sin\tau-\frac{1}{2}\sin 2\tau)$$

$$\cos\gamma=\frac{1}{\kappa}(\cos 2\tau-\frac{3}{2}\cos\tau)=\frac{-1+5\sqrt{5}}{4\sqrt{11}}$$

$$\sin\gamma=\frac{1}{k}(\sin 2\tau+\frac{1}{2}\sin\tau).$$

Hence

$$\beta=23^{\circ}\ 20'\ 46''$$
$$\gamma=140\ \ 7\ \ 6\tfrac{1}{2}$$
$$5\omega=2\beta+\gamma=186^{\circ}\ 48\ 38\tfrac{1}{2}$$
$$\omega=37^{\circ}\ 21\ 44$$
$$\omega^{(\varrho)}=\omega-\varrho\times 72^{\circ}:$$

$$\cos a^{\varrho}\varphi=-\frac{1}{10}+\frac{\sqrt{11}}{5}.\left\{\cos\omega^{(\varrho)}+\cos(2\omega^{\varrho}-\beta)\right\}.$$

By making ϱ successively equal to 0, 1, 2, 3, 4, the formula will give all the ten cosines of a polygon of 11 sides inscribed in a circle; because $\cos\frac{360^{\circ}}{11}=\cos 10.\frac{360}{11}$, $\cos 2.\frac{360}{11}=\cos 9.\frac{360}{11}$, &c. It determines also the order of the arcs to which the numerical quantities belong; so that when the value of one cosine is fixed, the values of all the rest are likewise ascertained.

This last formula coincides with the calculation of Legendre.

The next example shall be the case of $p=17$. Then, $n=8$, $k=\frac{1}{2}\sqrt{17}$, $\tau=\frac{360}{8}=45^{\circ}$, and $e=\cos\tau+\sin\tau\sqrt{-1}$; and, 3 being one of the primitive roots of 17, we may take $a=3$. Now, arranging the powers of a as in the last example, we have

$$a^0,\ a^6,\ a^1,\ a^4,\ a^5,\ a^7,\ a^3,\ a^2$$
$$1,\ 2,\ 3,\ 4,\ 5,\ 6,\ 7,\ 8:$$

and hence,

$$i=6$$

$h(1)=4$	$h'(1)=6$
$h(2)=2$	$h'(2)=3$
$h(3)=2$	$h'(3)=7$

Equations.

$h(4)=5 \qquad h'(4)=1$
$h(5)=7 \qquad h'(5)=4$
$h(6)=1 \qquad h'(6)=0$
$h(7)=3 \qquad h'(7)=5.$

By substituting these numbers in the expression of A, and likewise by putting $m=1$, we get

$$\begin{aligned}A=&\tfrac{1}{2}e^{-6s}+\tfrac{1}{2}e^{1-4s}+\tfrac{1}{2}e^{1-6s}\\&+\tfrac{1}{2}e^{2-2s}+\tfrac{1}{2}e^{2-3s}\\&+\tfrac{1}{2}e^{3-2s}+\tfrac{1}{2}e^{3-7s}\\&+\tfrac{1}{2}e^{4-5s}+\tfrac{1}{2}e^{4-s}\\&+\tfrac{1}{2}e^{5-7s}+\tfrac{1}{2}e^{5-4s}\\&+\tfrac{1}{2}e^{6-s}+\tfrac{1}{2}e^{6}\\&+\tfrac{1}{2}e^{7-3s}+\tfrac{1}{2}e^{7-5s}.\end{aligned}$$

In order to have the functions (1, 2), (1, 3), (1, 4), nothing more is necessary than to substitute 2, 3, 4 for s in the expression of A : then, observing that $e+e^5=o$, $e^2+e^6=o$, $e^3+e^7=o$, we readily get

$$(1,\,2)=\tfrac{3}{2}e^4+e^7+e^5=-\tfrac{3}{2}-\sqrt{-2}=-m$$

$$(1,\,3)=1+\tfrac{1}{2}e^4+2e^6=\tfrac{1}{2}-2\sqrt{-1}=n$$

$$(1,\,4)=\tfrac{3}{2}+e+e^3=\tfrac{3}{2}+\sqrt{-2}=m:$$

and hence,

$$(-1,\,-2)=\tfrac{3}{2}e^4+e+e^3=-\tfrac{3}{2}+\sqrt{-2}=-m'$$

$$(-1,\,-3)=1+\tfrac{1}{2}e^4+2e^2=\tfrac{1}{2}+2\sqrt{-1}=n'$$

$$(-1,\,-4)=\tfrac{3}{2}+e^7+e^5=\tfrac{3}{2}-\sqrt{-2}=m'$$

These values being found, we next have

$$P^4=(1,\,2)\,.\,(1,\,3)\,.\,(1,\,4)\,.\,f(0,\,4);$$
$$f(0,\,4)=\pm k:$$

therefore, making $f(0,\,4)=-k$,

$$P^4=m^2nk$$

$$P'^4=\frac{k^3}{P^4}=m'^2n'k:$$

and hence,

$$\frac{1}{k}P=\frac{1}{k}(m^2nk)^{\frac{1}{4}};\ \frac{1}{k}\,.\,P'=\frac{1}{k}(m'^2n'k)^{\frac{1}{4}};$$

$$-\frac{m'}{k}\,.\,\frac{P^2}{k^2}=-\frac{1}{k}\,.\,\sqrt{nk};\ -\frac{m}{k}\,.\,\frac{P^2}{k^2}=-\frac{1}{k}\sqrt{n'k};$$

$$-\frac{m'}{k}\,.\,\frac{n'}{k}\frac{P^3}{k^3}.=-\frac{1}{k}(m^2n'k)^{\frac{1}{4}};\ -\frac{m}{k}\,.\,\frac{n}{k}\,.\,\frac{P'^3}{k^3}=-\frac{1}{k}(m'^2nk)^{\frac{1}{4}};$$

Equations.

$$\begin{aligned}\cos a^{\varrho}\varphi=&-\frac{1}{16}-(-1)^{\varrho}\,.\,\frac{\sqrt{17}}{16}\\&+\frac{1}{8}\,.\,\left\{e^{-\varrho}(m^2nk)^{\frac{1}{4}}+e^{\varrho}(m'^2n'k)^{\frac{1}{4}}\right\}\\&-\frac{1}{8}\,.\,\left\{e^{-2\varrho}(nk)^{\frac{1}{2}}+e^{2\varrho}(n'k)^{\frac{1}{2}}\right\}\\&-\frac{1}{8}\left\{e^{-3\varrho}(m^2n'k)^{\frac{1}{4}}+e^{3\varrho}(m'^2nk)^{\frac{1}{4}}\right\}.\end{aligned}$$

In order to reduce this expression, we shall put

$$\varphi(\varrho)=e^{-2\varrho}\sqrt{nk}+e^{2\varrho}\sqrt{n'k}$$
$$\begin{aligned}\Psi(\varrho)=&e^{-\varrho}(m^2nk)^{\frac{1}{4}}+e^{\varrho}(m'^2n'k)^{\frac{1}{4}}\\&-e^{-3\varrho}(m^2n'k)^{\frac{1}{4}}-e^{3\varrho}(m'^2nk)^{\frac{1}{4}}.\end{aligned}$$

And, because $e^4=e^{-4}=-1$, we get $e^{6\varrho}=e^{-2\varrho}=(-1)^{\varrho}\,.\,e^{2\varrho}$, and $e^{-6\varrho}=e^{2\varrho}=(-1)^{\varrho}\,.\,e^{-2\varrho}$. Wherefore, by squaring,

$$\left\{\varphi(\varrho)\right\}^2=2k^2+(-1)^{\varrho}\,.\,k$$

$$\left\{\Psi(\varrho)\right\}^2=4k^2-6k(-1)^{\varrho}+3\varphi(\varrho)-2k.\varphi(\varrho).(-1)^{\varrho}.$$

Now, in the formula for $\cos a^{\varrho}\varphi$, viz. $\cos a^{\varrho}\varphi=-\frac{1}{16}-(-1)^{\varrho}.\frac{\sqrt{17}}{16}-\frac{1}{8}\varphi(\varrho)-\frac{1}{8}\Psi(\varrho)$, if we change ϱ into $\varrho+4$, no alteration will be produced, except that $\Psi(\varrho)$ will change its sign ; for, it is obvious, that

$$\Psi(\varrho+4)=e^4\,.\Psi(\varrho)=-\Psi(\varrho).$$

Hence, we readily deduce these two equations, viz.

$$\frac{1}{2}(\cos a^{\varrho}\varphi+\cos a^{\varrho+4}\varphi)=-\frac{1}{16}-(-1)^{\varrho}\,.\,\frac{\sqrt{17}}{16}-\frac{1}{8}\varphi(\varrho)$$

$$\frac{1}{4}(\cos a^{\varrho}\varphi-\cos a^{\varrho+4}\varphi)^2=\frac{1}{64}\times\left\{\Psi(\varrho)\right\}^2.$$

If we suppose $\varrho=o$, then

$$\left\{\varphi(o)\right\}^2=2k^2+k;$$

wherefore,

$$\frac{1}{2}(\cos\varphi+\cos a^4\varphi)=-\frac{1}{16}-\frac{\sqrt{17}}{16}-\frac{1}{8}\sqrt{2k^2+k},$$

$$\frac{1}{4}(\cos\varphi-\cos a^4\varphi)^2=\frac{1}{64}\,.\,\left\{4k^2-6k-(2k-3)\times\sqrt{2k^2+k}\right\}.$$

And, when $\varrho=2$, then

$$\varphi(2)=e^4\,.\,\varphi(0)=-\varphi(0);$$

wherefore,

Equations.

$$\frac{1}{2}(\cos a^2\varphi+\cos a^6\varphi)=-\frac{1}{16}-\frac{\sqrt{17}}{16}+\frac{1}{8}\sqrt{2k^2+k}$$

$$\frac{1}{4}(\cos a^2-\cos a^6\varphi)^2=\frac{1}{64}\cdot\left\{4k^2-6k+(2k-3)\times\sqrt{2k^2+k}\right\}.$$

Next, suppose $\varrho=1$, then

$$\left\{\varphi(1)\right\}^2=2k^2-k;$$

wherefore,

$$\frac{1}{2}(\cos a\varphi+\cos a^5\varphi)=-\frac{1}{16}+\frac{\sqrt{17}}{16}+\frac{1}{8}\sqrt{2k^2-k}$$

$$\frac{1}{4}(\cos a\varphi-\cos a^5\varphi)^2=\frac{1}{64}\cdot\left\{4k^2+6k+(2k+3)\sqrt{2k^2-k}\right\}:$$

and, finally, making $\varrho=3$, we get

$$\varphi(3)=e^4\times\varphi(1)=-\varphi(1):$$

wherefore,

$$\frac{1}{2}(\cos a^3\varphi+\cos a^7\varphi)=-\frac{1}{16}+\frac{\sqrt{17}}{16}-\frac{1}{8}\sqrt{2k^2-k}$$

$$\frac{1}{4}(\cos a^3\varphi-\cos a^7\varphi)^2+\frac{1}{64}\cdot\left\{4k^2+6k-(2k+3)\sqrt{2k^2-k}\right\}$$

These formulæ enable us to find the numerical values of all the cosines sought; observing always that φ is indeterminate, and varies with the primitive root from which the solution is deduced. (C. C.)

TABLE

OF THE

ARTICLES AND TREATISES

CONTAINED IN THIS VOLUME.

ERRATA.

Dissertation Second, p. 66, line 10, *for* " the quantities of matter are as the mean distances," *read* " the qualities of matter are as the orbits of the mean distances."

Page 316, col. 1, line 31, *for* " canal below," *read* " canal between."
—— 318, col. 1, second line from bottom, *for* " the fluid will there," *read* " will therefore."
———— col. 2, line 40, *for* " case where," *read* " case when."
———— line 56, *read* $\frac{1}{2}$H.
—— 319, col. 1, line 40, *for* " outside of the force," *read* " outside of the four."

DIRECTIONS FOR PLACING THE PLATES.

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